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The Borchardt Repeating Pistol.

For some time past occasional rumors have been heard of a new and very remarkable small arm made by Ludw. Loewe & Co., of Berlin, upon what is called the Borchardt system. There have been a few crude engravings of it published—engravings revealing little or nothing of its construction. We take pleasure, therefore, in presenting on this and the succeeding page, some engravings made from photographs and working drawings which will give a pretty accurate idea of the construction of this the latest development in firearm manufacture—an arm that is as great an improvement over the ordinary revolver for military purposes as was the revolver over the old-time horse pistol.

In the plate of details No. 1 is the barrel, which is shown screwed into the receiver No. 34, which latter slides in the guides on top of the grip No. 3 (19–22–60), No. 41 is the breech block, No. 43 the firing bolt, and No. 47–49 is the toggle joint.

The grip No. 3 is made in one piece with the trigger guard, guides and casing for receiver and lock mechanism, such latter portions having separate numbers for reference. No. 10 is the trigger, No. 35 the sear, No. 7 the safety piece, No. 61–67 the magazine, and No. 68–71 the feeding spring.

The magazine, which is contained within the grip, holds 8 center fire cartridges which are brought to the front of the breech block when the latter is moved to the rear in opening the breech, and closing the breech places the cartridge in its proper position in the firing chamber.

The recoil at firing drives the barrel and breech mechanism to the rear, the three friction rolls of the rear link 51–52–53 strike against the curved butt and are forced downward, the middle joint of toggle is raised, and the breech block recedes taking with it the empty shell by means of the extractor, No. 46, until the ejector, No. 14, strikes the shell from below, and throws it out, and the surplus momentum of the recoiling ports is taken up by the recoil spring, against which the friction rolls impinge.

As soon as the recoil, which is so eased as to be scarcely noticeable to the hand, is spent, the springs draw the toggle link, No. 49, forward, and downward, the breech block pushes the upper cartridge into the barrel, and the firing bolt is arrested and held cocked by the sear.

The action of the piece is so rapid that the eye cannot follow the movements, and the eight shots can be fired before the first shell ejected has struck the ground.

The safety piece prevents accidents when the arm is not in action, otherwise the pistol is always cocked and ready for service while cartridges remain in the magazine.

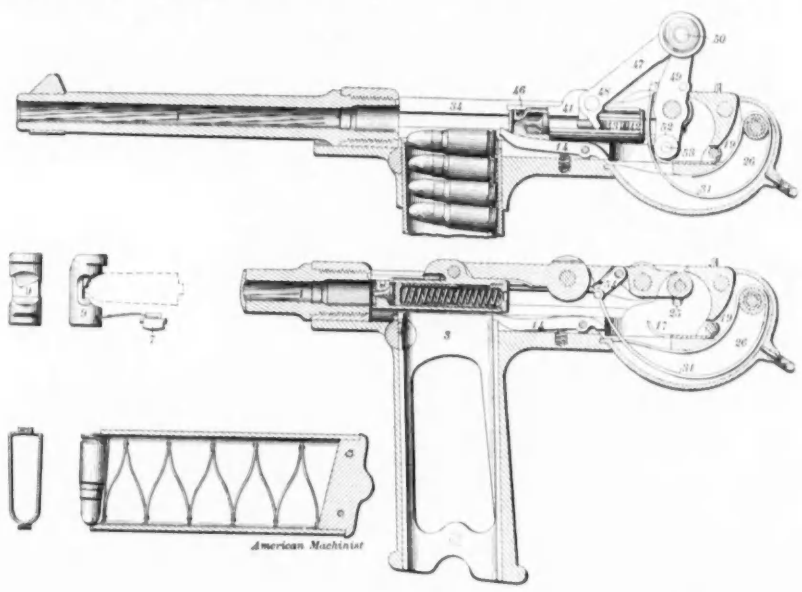
The weight of the pistol with 6-inch (= 154 mm.) barrel is 2¾ pounds (= 1,250 gramme), and with a 7½-inch barrel (= 190 mm.) $2\frac{81}{100}$ pounds (= 1,275 gramme).

The cartridge which is 1.4 inches long (= 35 mm.) carries a projectile of 85 grains (= 5.5 gramme), and projects it at a velocity of about 1,300 feet per second (= 400 meters).

The rifling is one turn in 10 inches (= 250 mm.), and the caliber is 0.3 inches (= 7.65 mm.).

A buttstock and cover is fitted for military purposes when required, as is also a shoulder piece when the arm is to be used for sporting.

The plate of details on page 122 includes all parts of the pistol.



THE BORCHARDT REPEATING PISTOL.

The Proposed New Standard Screw Thread.

In our issues of January 3d and 24th we gave particulars of a proposed new standard screw thread which it is thought might with advantage supersede square threads in most cases, and the numerous forms of bastard threads in all cases.

Thinking it would be a matter of interest to tool builders, especially as well as to others, we have asked several well-known firms and mechanics to give us their views upon the matter. Others have volunteered opinions, and we print them below :

Mr. F. A. Pratt, president of the Pratt & Whitney Co., writing for that company, says :

Replying to your favor of 3d inst., we notice in your issue of same date an article relating to square thread screws. We seldom make a square thread for a lathe leading screw, but make it at an angle of 15 degrees, for the reason that we use nuts that are in halves, and are opened and shut when in use. A leading screw should be cut of a greater depth than one-half of the pitch. We cut our leading screws and worms the depth of a gear tooth, which is 2 pitches deep, diametral pitch, or 0.6366 of the circumference pitch. Nearly all of our small square thread screws are cut one-half the pitch in depth, and square or with a slight angle, only enough to permit the tool to make the sides smooth, for the reason that by leaving the top and bottom of thread with a clearance, a perfect alignment is not necessary. We see no reason why the same angle of 15 degrees or 14½ degrees cannot be adopted, but for good reasons the depth should not be confined to one-half of the pitch in all cases.

H. J. Hendey, president of the Hendey Machine Co., says:

We have been using the Brown & Sharpe worm gauge as a standard for our lead screws on lathes, and the feed screws on lathes, shapers and planers, etc., and our drawings show it was adopted in 1887. We vary the depth of the thread to suit different work, but the angle is always made to the Brown & Sharpe gauge, thus insuring a perfect standard for all of our work.

We long since found it an advantage over the square threads in making a fit in the nut, as it is almost impossible to do so on a square thread, and the square thread nut seems to lose its size quicker than the angle thread. We would not under any consideration go back to the square thread on our work. We hope this will come into general use on machine tools.

There is also another matter in this connection which we have often thought of bringing before builders of machine tools. Why should we not have a standard for the thread on the nose of the spindle of a lathe, and also for the taper in the end of the spindle, and, if possible, the size of hole through the spindle? It is often a source of annoyance to have as many different threads on the lathe spindles as there are lathes in the shop, and to be compelled to have separate chucks and fixtures for each lathe. It is no advantage to the builders of lathes for each to have a different standard for the thread of spindle and the taper in end of spindle, and it would certainly be an advantage to their customers to be able to buy a lathe and know that the fixtures which they already have in use would fit. We would be pleased to have this matter ventilated a little in your paper, and it is

possible something might be brought about to improve our tools in this respect.

We have always advocated a rather coarse thread on the end of the spindle, as we have found in service that the finer threads wear out much faster, and lose their size. We also advocate the use of a large round corner on the spindle at the end of the thread, and next to the shoulder of spindle for the face plate to come up to. This adds to the strength of the spindle and improves the quality of the work from the lathe.

We hope to hear from some of your readers in regard to the several matters mentioned herein.

George K. Garvin, president The Garvin Machine Co., says:

We are at present making some screws on the lines laid down in your article in January 3d issue. While the tools worked satisfactorily, and have produced good screws, we would be unable to give you our views on the subject until we have thoroughly tested the screws in actual operation.

nut, and because it accords with a worm thread already adopted, the only difference being the unimportant matter of clearance.

When a leading screw is of such length as to sag, it may be well to have no clearance at the bottom of the thread, so that the nut will help to keep the screw in place; this, however, may be more of a refinement in thought than in fact. The clearance is a convenience when taps and dies are used in threading, as is the case on bolt-threading machines. We can really see no objection, although there might possibly be in some cases.

The formula referred to by Mr. Viall is in the form of a blue print, and is as follows:

FORMULÆ FOR 29° ANGULAR SCREW THREADS.

This gives Brown & Sharpe Mfg. Co.'s practice at the present date, but is subject to change.

March 12, 1894.

Width of point of tool for tap, screw or tap thread $= (.3354 \times P) -$ constant .0026.

Width of screw or nut thread $= .3354 \times P$.

is required we think it will prove the most economical.

Chas. A. Bauer, M. E., writing on another matter, in the course of his letter, says:

Referring to the "Proposed New Standard Screw Thread" more particularly as a substitute for square threads, an angle of 14½ degrees, as proposed, has no disadvantage as compared with the square threads. For myself, however, I would prefer an angle of 12 degrees, because in many places, like lead screws of lathes, etc., split nuts are used, and the question is whether the threads with a side angle of 14½ degrees would not tend to force the nut apart, while with a thread angle of 12 degrees the forces might balance, the nut having neither a strong tendency to open, nor to resist opening when we wish to open it.

Before adopting such a standard it would be well to test the different angles in order that the best proportions will not escape us.

rious sorts used continuously, or approximately so, for the purpose of producing various traversing motions, we meet with an entirely new set of conditions. In the first place, it is desirable to save power as well as undue wear by reducing the pressure upon the sides of the threads as much as possible, and this can evidently be best attained by the use of the square-threaded screw. Then, too, the majority of the feed screws in question are of comparatively large size and coarse pitch, so that there is but little difficulty in regard to the breaking of the lathe tools or of the die and tap teeth used in their construction. In cases where this is not true, but where small diameters and fine pitches are required, the ordinary U. S. standard thread is usually good enough, as in small work the loss by friction is not so well worth considering. Furthermore, the feed screws in question do not usually require such great strength, as their work is generally comparatively light in proportion to the diameter of screw and the width of thread.

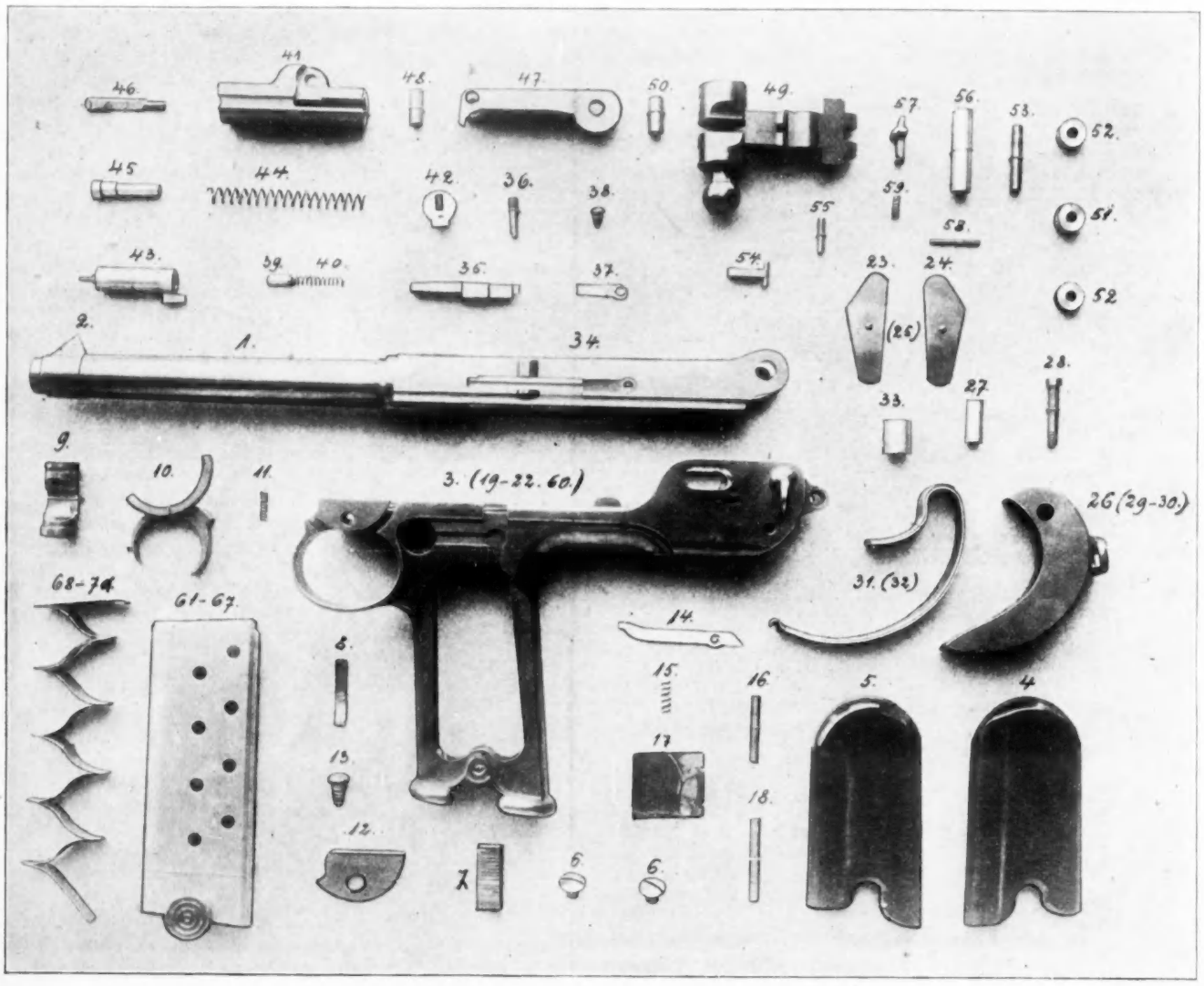
An incidental advantage sometimes occurring with square-threaded screws is that the nut need not be made accurately in line with the screw, but can be located only approximately concentric with, its diameters being made large enough to allow some lateral play, while at the same time the threads fit properly to prevent endwise play. The fit of the thread is, of course, under such conditions, not theoretically correct, but, practically, it is near enough so—at any rate upon screws of large diameter. With V-threads of any sort the practical point above mentioned cannot be taken advantage of, as the endwise pressure of the screw must necessarily force it into the center of the nut, just like any other wedge.

Another advantage of a square-threaded screw is (contrariwise as my logic may appear) that in cases where it *is* desirable for it to be concentric with the nut as, *e. g.*, where the latter acts as the support of a long screw which otherwise would sag or spring out of position, both top and bottom of the threads may be made a good running fit with each other, so that they act relatively after the manner of a shaft and its journal box. Furthermore, their functions in this aspect of the case are not disturbed by the wear upon the sides of the threads, which usually takes place faster than elsewhere.

In the case of a V-thread this journaling action, so to speak, cannot be so well attained, even if the cylindrical parts fit each other, because they are so small in amount as to soon wear loose in respect to diameters. This objection is especially prominent in the new thread proposed, on account of the clearance of .01" at top and bottom of thread, thus giving a lateral play of two-hundredths-inch, *providing* the tapering surfaces of the threads were made to fit sufficiently loose, which obviously they are not intended to be at first. They would doubtless become so after a time, but, meanwhile, another difficulty would be always present, viz., the wedging of the threads into nut spaces in a radial direction. This wedging at an angle of 29 degrees would cause very serious friction as well as abnormal wear of the surfaces.

From the above it is evident that we may definitely condemn the new thread for all cases where there is likely to be much side pressure between nut and screw, although for cases where the screw is short, and, preferably, in a vertical position, and where the nut is properly held in alignment, such a screw would practically serve a very good purpose.

Another argument in favor of a square-threaded screw is that where it is made with ordinary tools and without special gauges, it is easier to construct, because the measurements are all "fair and square," so to speak, both in regard to depth and width. If, on the contrary, the cross-section of the thread is made up of a rectangle and two triangles, as is the case with almost all of the V-like forms, there is more difficulty in getting both angles alike, and in knowing at what point to measure the width, etc., than in the case of a rectangular section.



THE BORCHARDT REPEATING PISTOL.—SEE PAGE 121.

A. C. Stebbins, vice-president The Pond Machine Tool Co., says:

The thread you call our attention to has been in use in our works for many years, we should think ten. This fact we think sufficient expression of our opinion regarding its practicability.

R. Viall, superintendent Brown & Sharpe Mfg. Co., says:

We think the "Acme" standard form of thread, proposed in your issue of January 3, 1895, is an improvement over the old square thread.

For a number of years we have made some of our leading screw threads the same shape as a common worm thread, only we did not have so much clearance at the top and bottom of the leading screw as in a worm. About two years ago we adopted very generally the thread shown in formulæ we send you.

As you will see by the formulæ, we have preferred a thread somewhat deeper than the square thread. This preference is because of more wearing surface, and consequent longer life-time of the screw and

Diameter of tap at top of thread = diameter of screw + .010.

Diameter of tap or screw at root or core = diameter of screw $-$ [(1.2732 $\times$ P) + .010].

Diameter to bore nut = diameter of screw $-$ (1.2732 $\times$ P).

Thickness of thread at pitch line = ½ P.

Distance from top of thread of screw to pitch line = P $\times$ .3183.

Distance from top of thread of tap to pitch line = [(P $\times$ .3183) + .005].

Edwin A. Muller, superintendent Springfield Machine Tool Co., says:

We followed the article describing a proposed new screw standard with considerable interest.

This we believe to be a step in the right direction, inasmuch as we consider the form advocated with the clearance suggested by the Brown & Sharpe Co. superior to the square thread for nearly all purposes.

In our opinion the cost of this form will exceed that of the square thread for ordinary purposes. Where, however, accuracy

Mr. Oberlin Smith, president of the Ferracute Machine Co., says:

It is evident that the chief fault of any V-threaded screw is the extra friction between screw and nut, caused by the approximately conical surfaces trying to wedge themselves into one another by reason of the pressure in the line of the axis. This, however, is hardly worth considering in connection with ordinary forms of bolts, set screws, etc., as the actual moving of the nut is taking place during an almost infinitely short time in comparison with the life of the bolt. That is to say, the tightening up of either bolt or nut is usually done, but at very infrequent intervals, and, too, the objectionable friction referred to occurs only at the moment of final pressure. Furthermore, this friction is often an actual benefit as it makes the nut less likely to work loose of itself. All this, of course, refers to bolts and screws used as permanent fastenings, and not as active working members of the mechanism in which they are employed.

When we come to consider the class of screws for which the new thread is proposed, which consists chiefly of feed screws of va-

To sum up this whole question, it seems to me that the disadvantages of the proposed new form of thread considerably outweigh its advantages as a standard for general use, to say nothing of the trouble of making the change and of procuring the necessary special tools. In saying this I do not wish to disparage attempts at standardizing constructions of this kind; for it is very desirable that more uniformity should be practiced among our machine makers, and this applies, among other things, to the case of feed screws of machine tools. We should all gladly welcome any attempt to get the makers in question together in spirit and afterwards in practice, in regard to so important a matter as this. It hardly seems to me likely that the thread proposed will confer enough benefits to warrant its adoption, although I may be mistaken. If, however, it should be adopted by a large majority of the machine-making craft, I should be glad to fall into line with the rest, as it is often more desirable to have uniformity and standardization than to attain to the best possible ideal form. Should such adoption take place I sincerely hope that the two-hundredths-inch looseness in the nuts will be reduced to, say, two or three-thousandths-inch, about as in the case of an ordinary good running fit. It would also be desirable to change the 29 degrees contained angle between the sides of the thread to 30 degrees, *providing* the worm-thread gauges could be changed also.

In regard to the desirability of this latter point I will not advance a positive opinion, as I have never made a sufficiently careful study of the forms of rack teeth to make up my mind whether it is really necessary to use the theoretical angle of 14½ degrees with the normal plane, rather than the more convenient angle of 15 degrees. It often happens that some wild-cat measurement of this kind, based only upon the mathematics of the question, is cruelly perpetuated in iron and steel because it seems theoretically best, while practically some closely approximate measurement would really do just as well. If, however, we are to retain this rather awkward angle in our racks and worms for sufficiently good reasons, probably then any new thread of about the same shape had better agree exactly therewith rather than nearly—such agreement being in the line of that simplicity and uniformity which is so desirable in all machine construction.

As the editor has asked an expression of opinion upon this question from the Ferracute Machine Company, whose practice I happen to control, I would say in its behalf that its tool room would prefer to be let alone and to "cling to its idols," so to speak. Should, however, some new and practically useful form of thread be generally adopted, with tools and gauges therefor freely on sale in the market, said tool room might yet be open to conviction and conversion.

Graphic Analysis of Paddle Wheels With Fixed and With Feathering Floats—I.

By CHAS. M. JONES.

RADIAL WHEELS.

In Fig. 1 C is the center of shaft, and $C\ S$ and $C\ S'$ are, respectively, the outer and inner radii of floats of an ordinary radial wheel.

$S\ S'$ is called the depth of float, while the horizontal length, perpendicular to the fore and aft line of ship, is called the breadth. The distance below surface of water of outer edge of float is called the dip, while the depth of inner edge is known properly as the immersion.

These terms are often rather loosely applied, and in working up published trial data the meanings must not be taken for granted, as "immersion" is often substituted for "dip," breadth for depth, etc.

Draw $S\ U$ in the direction of the vessel's motion and equal by any scale to the velocity of that motion, in feet per second. From U draw $U\ T$ perpendicular to $C\ S$, and equal to the circumferential velocity of S, in feet per second, and join S, T, then $S\ T$ will be the instantaneous velocity in feet per second, and also the direction of motion of the edge S of float when in the given position.

Let R be another position, for which the "motion" is to be found.

Draw $R\ V$ horizontal and equal to vessel's velocity, and $V\ W$ perpendicular to the radius $C\ R$, and equal to circumferential speed of R, complete the triangle, by joining R and W, then $R\ W$ is the motion of R, both in direction and velocity.

The horizontals $S\ U$, $R\ V$ are constant (being equal to the ship's velocity) and so also are $U\ T$ and $V\ W$ for the same radius. But the velocity of rotation varies as the radius, and the "motion" is different for different radial positions.

The construction given is general, and by finding the circumferential velocities, the motion at any radius can be laid down, but considerable trouble is avoided by the following simple means:

Lay off $C\ D$ equal to, and in the direction of the vessel's velocity in feet per second.

From F, the lowest point on the vertical, draw $F\ K$ in the direction of rotation, and equal to the "slip" in feet per second, which slip is the difference between the circumferential velocity of the point F, and the forward velocity of vessel.

Draw $D\ K$, and from D as center, describe an arc $Z\ K\ T$ through K, as shown, then is this arc the "motion curve," and $D\ K$ is the initial line.

Let P be a point for which the motion is required. Take the angle $K\ D\ Z$ equal to $F\ C\ P$, and draw $P\ Z$, this last line gives by scale the velocity, and also the direction of motion for the point. Take $K\ D\ W = F\ C\ R\ (= \beta)$, $R\ W$ will be the "motion" of R, as found by the first method.

Draw $H\ L$ and $J\ M$ to $D\ K$, and describe the arcs as shown. These arcs will be the motion curves for the radii $C\ H$ and $C\ J$, respectively.

Since $D\ Z$, $D\ W$, etc., cut these curves at the proper angles for the float positions P and R, the lines $p\ z'$, $p'\ z''$ are at once the motions of the points p and p', and $r\ w$ and $r'\ w'$ are the respective motions of the points r and r' at float position R.

Taking $K\ D\ T' = F\ C\ S\ (= \beta + \Theta)$, $s\ t$ and $s'\ t'$ are the motions for points s and s' on the float, the outer edge S of which is just entering the water.

The construction applies to the complete circle as well as to the water arc. All angles to the right of $C\ F$, for float positions, must be taken to the right of $D\ K$ for points on motion curves.

The line $D\ K$ will aways pass through the vertical $C\ F$ at such a point O that $C\ O$ is the radius of rolling circle, or circle equal in circumference to the vessel's advance in one revolution of wheel.

The point O is the instantaneous axis for the whole wheel, and each and every point on the floats, or on any part whatever that is rigidly attached to the wheel, is moving, at any instant, at right angles to a line drawn from O to the given point, and the velocities of such motions are proportional to the distance from O; that is, $S\ T$ is perpendicular to $O\ S$, and $R\ W$ is perpendicular to $O\ R$.

$$\text{Also, } \frac{S\ T}{R\ W} = \frac{O\ S}{O\ R}$$

The velocities are equal for the same radii, making equal angles to right and left of $C\ F$, and the angles which the motion lines make with the face of float are also equal.

Draw $S\ Y$ perpendicular to the face of entering float $S\ s'$, then $C\ Y$ will be the radius of rolling circle which would make the float enter edgeways.

Draw $D\ Y$ and take $F\ f$ horizontal, then $F\ f$ is the *negative* slip of outer edge of paddle float necessary to allow the float to enter edgeways. $H\ h$ and $J\ m$ are the negative slips of middle and inner edge of floats.

It is usually asserted that the slip of a paddle wheel is a measure of the propulsive effect, that unless there is slip there can be no reaction upon the wheel.

In Fig. 2 C is the center of shaft and D the center of motion curves, $C\ D$ being equal to the ship's speed in feet per second.

The greatest circumferential velocity is taken equal to the speed of ship, so that there is zero slip at outer edge of floats, and $D\ d$, the initial line of motion curves, passes through the outer edge of float at O, and, therefore, $C\ O$ is the radius of rolling circle.

Dividing the water arc into a number of parts, and the motion circles into their proper corresponding divisions, the instantaneous motion of points on the float for the various positions in water arc are found, as shown in figure; (the motion is always *from* the point on float *towards* the point on motion circle).

With a radius equal to half that of the rolling circle describe a circle on the rolling circle radius as shown; then all points on the float that pass into the circle so drawn, have negative slip, and *when sweeping through the shaded area* retard the advance of vessel.

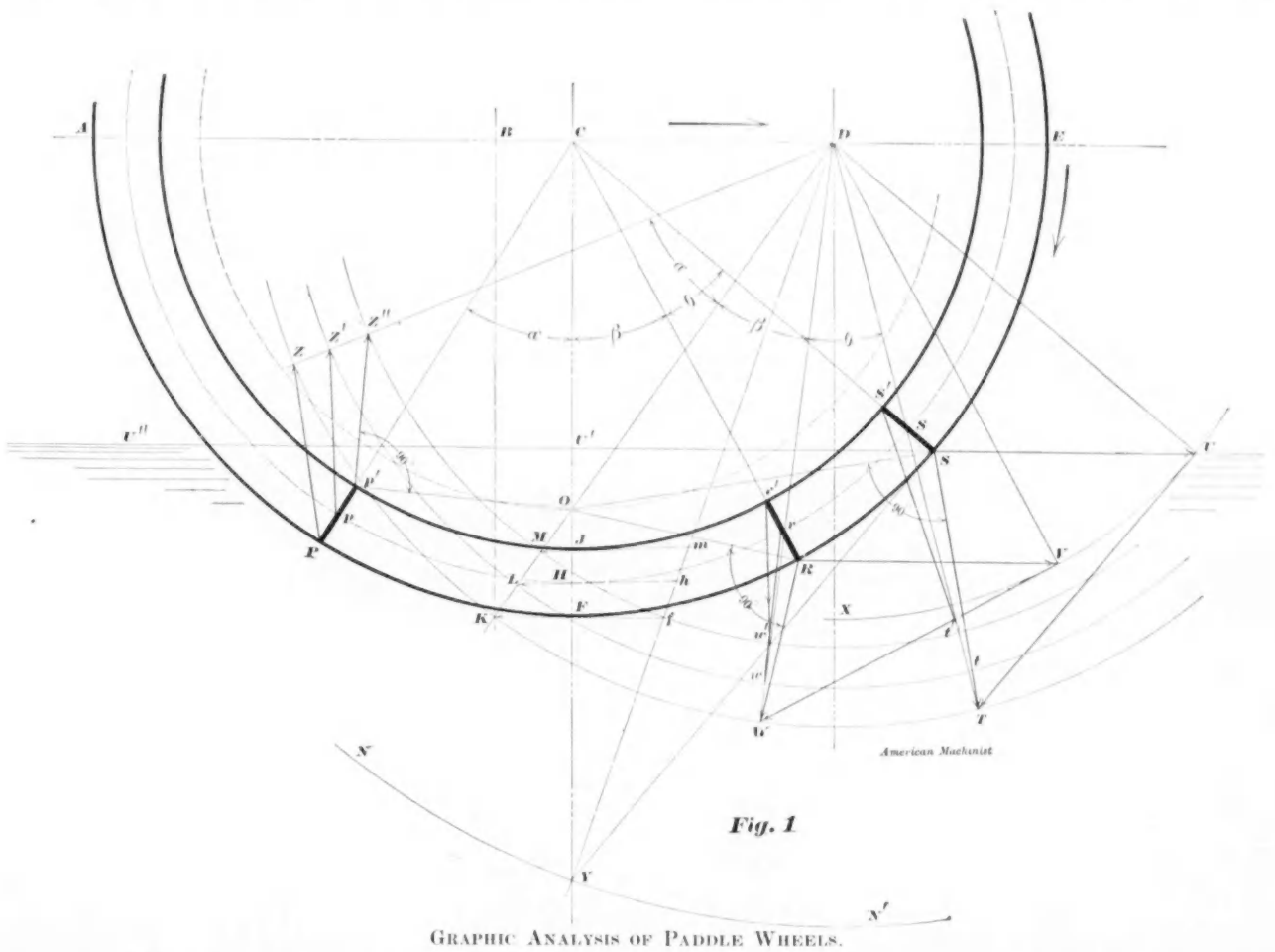


Fig. 1

GRAPHIC ANALYSIS OF PADDLE WHEELS.

But all portions while outside of shaded path exert positive thrust, and as the velocities are greatest for the outer positions, a wheel may propel with negative slip.

Let A be the total *negative thrust* on the float when it is in the lowest position on the vertical $C\ O$, and let V be the velocity of vessel in feet per second. $A\ V$ is the rate of retarding work in foot-pounds per second *for the given position*, and $\frac{A\ V}{550}$ is the rate of E. H. P. required to drag the float.

But if x be the circumferential velocity of center of pressure of float in feet per second $A\ V - A\ x$ is the resultant rate of engine loss due to the float position, or $\frac{A\ V - A\ x}{550}$ is the rate of loss in A. H. P. (available horse-power) due to *the given position*.

The further the float is from its lowest position the greater is the component assisting the engines in comparison to that which retards the vessel, so that the loss, as a whole, is by no means what might be supposed.

In Fig. 2 (*d*) let $a\ d$ be the "motion" of a point a on a float.

Take $a\ b = \pi\ (= 3.1416)$ and draw $b\ c$ perpendicular to $a\ c$, the face of float; $b\ c$ will be by scale $= \pi$ sin. Θ.

Let v be the value of the motion $a\ d$ (the velocity in feet per second) then $2\ \frac{\pi \text{ sin. } \Theta}{4 + \pi \text{ sin. } \Theta}\ v^2$ is the intensity at a in pounds per square foot, of the pressure due to the motion of a.

On the back of float at a there will be a loss of head, and this may be taken as the loss due to normal velocity, or $v^2 \text{ sin.}^2 \Theta$, and the resultant *intensity* of force acting normally at a is therefore $p = \left(2\ \frac{\pi \text{ sin. } \Theta}{4 + \pi \text{ sin. } \Theta} + \text{sin.}^2 \Theta\right) v^2 =$ pounds for *salt water* (for fresh water multiply result by 0.97). Since $a\ d = v$, a perpendicular from d to $a\ c$ is by scale, v sin. Θ, and $(d\ c)^2 = v^2 \text{ sin.}^2 \Theta$. The quantities are, therefore, all scaled from the diagram, and little direct calculation is necessary.

Find the resultant intensity for outer, middle and inner radius of float, and multiply each value by B, the breadth of wheel (or, rather, length of paddle board).

In Fig. 2 (*e*) set off at their proper positions on the float, p, p', and p'', equal by any scale to the calculated intensities multiplied by B, as above, and draw a curve through the ordinates, as shown.

The area of the figure in square feet, measured to the scale by which $A\ B$ was laid down, multiplied by the scale of pounds (to the $A\ B$ scale of feet) is the total normal force acting on the float in the given position in water arc at given speeds.

For example, suppose the float to be 2 feet depth and 10 feet long (breadth of wheel) and (neglecting the middle ordinate for simplicity) let the values of $2\ \frac{\pi \sin.\ \theta}{4 + \pi \sin.\ \theta}\ v^2 + v^2 \sin.^2 \theta$ for the inner and outer edges be respectively 50 and 100 pounds.

In Fig. 2 (*c*) draw $A\ B = 2$ feet by a scale of, say, 1 inch = 1 foot and set off $p = 50 \times 10$ feet = 500 pounds, and $p'' = 100 \times 10$ feet = 1,000 pounds, by a scale of, say, 500 pounds per *actual* inch (lineal). The area will measure $\frac{p + p''}{2} \times A\ B = 1\frac{1}{2} \times 2 = 3$ square feet by the 1 inch = 1 foot scale, and multiplying by the scale of pounds per foot lineal of the $A\ B$ scale, $3 \times 500 = 1{,}500$ pounds = *total* force acting on the float.

The center of pressure can be calculated by the ordinary rules for center of gravity, but for practical purposes a readier way is to cut the figure out of a piece of ordinarily stiff paper, and piercing it with a needle find the position of same on $A\ B$ at which $A\ B$ hangs horizontally.

Where the float is but partially immersed, the pressures are to be calculated for at least two points on wet portions.

The surface friction acts parallel to the surfaces, and may be taken as about $f = 0.0045\ v^2$ pounds per square foot.

Multiply the total immersed area of *one* face of float by $0.009\ v^2$, and the product is the total frictional resistance for both faces. This resistance acts radially, and therefore does not affect the engines *directly*, but it reduces the effective thrust, and should not be neglected.

For practical purposes, the value of v for the middle point on float board may be used for calculating the friction on floats fully immersed, or the velocity of outer edge for partially wetted positions (v being "motion" in feet per second, as before stated).

The outer *edges* of entering floats are resisted by a total force $= 2\ \frac{\pi \sin.\ \delta}{4 + \pi \sin.\ \delta}\ v^2 \times t\ B$, where t is the thickness in fraction of a foot and B the horizontal length of board, or breadth of wheel; and the inner edges of entering float (*when immersed*) experience a drag, due to loss of head, equal to $v^2 \sin.^2 \delta$, v is, of course, different for the two edges, as is also δ (the acute angle between edge surface and line of motion v).

In the trailing portion of water arc, the inner edge strikes the water and the outer edge drags, and the formula must be reversed.

In Fig. 2 (*a*) set off P equal to the total normal forces due to pressure on face, and loss of pressure on back of float, as found for Fig. 2 (*c*), and draw $F + E$, as shown, equal to the friction and edge resistance. P is perpendicular to and $F + E$ parallel to the face of float. Connect P and $F + E$ by R, as shown. Then R is the total value and direction of action of the forces on the float when in the given position in water arc.

Resolve R into its vertical and horizontal components; the latter, t, is the thrust of the float in the given position.

Calculate the total force components for a number of positions of float in the water arc and mark on the positions 1, 2, 3, 4, etc. (Fig. 2), the position of center of pressure, and through these points draw a smooth curve. This curve will be the path of the center of pressure.

From a center line $c\ l$, Fig. 2 (*b*), set off—to right and left—the circumferential distances of the centers of pressure as measured from the middle position on $C\ O$, Fig. 2, and at each such distance point set up an ordinate equal to the total normal force (P of Fig. 2 (*a*)) due to such position of float in water arc.

Draw a smooth curve through the ends of the ordinates as shown by a, b, c, d, e, and the area multiplied by the scale of pounds, will be the total work in foot-pounds required to drive one float once through the water arc at the given speed.

Multiply the value so obtained by the number of floats, and again by the revolutions per minute, and divide by 33,000; the quotient will be the horse-power required to drive one wheel.

From the centers of pressure in the water arc draw verticals to $a\ e$ of Fig. 2 (*b*), and on them set up the thrust components for the thrust curve $i\ h\ c\ z\ f$. Find the mean hight of this curve, and multiply such mean hight (in pounds) by the mean number of floats in the water arc. The product is the mean total thrust of the wheel.

The mean number of floats in the water arc is equal to the total number in wheel, multiplied by the ratio of extreme water arc to extreme circumference.

The best way of finding the mean hight of the thrust area is to divide $f\ i$, Fig. 2 (*b*), into 10 equal parts, and at the *middle* of each such part draw an ordinate. The sum of the lengths of the 10 ordinates thus drawn, being divided by 10, gives the mean hight. The area of any figure can be accurately calculated by multiplying its length by its so found mean hight.

It is a good plan to lay off the negative thrust components of friction and edge resistance on a separate curve, such as $k\ l\ m$ of Fig. 2 (*b*).

The friction, etc., due to arms, rings, etc., can also be found by a simple modification of this method without much labor.

The *buoyancy* of floats affects the arms by shifting the ordinates towards the entering side, but the powers and mean thrust are not affected, velocity neglected, so that it is not usually necessary to note the change.

The above analysis gives a thoroughly good approximation for negative slip the positive and negative thrusts and resistances should be laid out on separate lines.

Having the I. H. P. of *any* radial paddle-wheel steamer, subtract the power required for working the engines *alone* (which will be due to about $1\frac{1}{2}$ pounds per square inch of pistons), the remainder is the net horse-power (N. H. P.) Allowing $7\frac{1}{2}$ per cent. for friction of load (very doubtful), multiply the N. H. P. by 0.925, the product is the power applied to wheels (A. H. P.), or available horse-power.

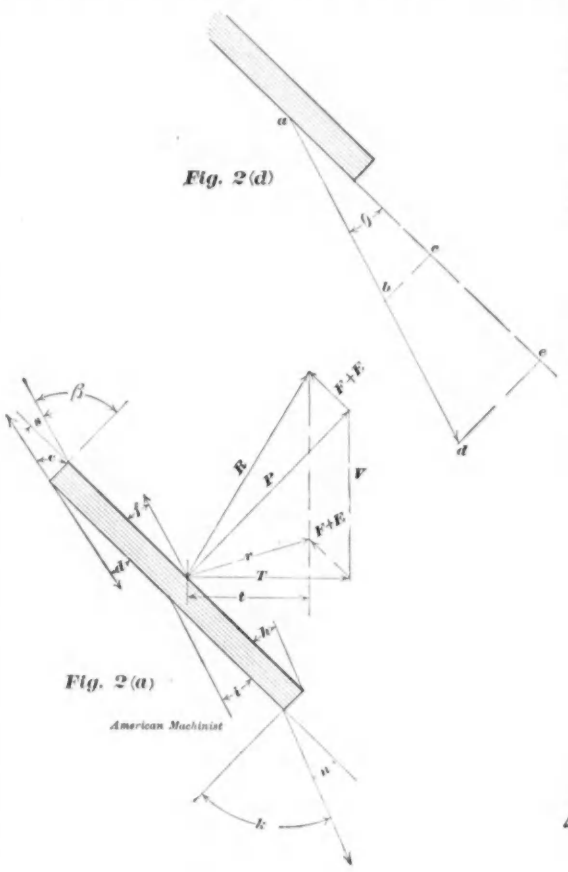
Multiply the available horse-power by 33,000, and divide by the circumferential velocity of mean center of pressure in *feet per minute*. The quotient is the mean resistance at the mean center of pressure.

Multiply this mean resistance by the ratio of water chord to water arc (taken at extreme radius of float), the product is the mean thrust nearly.

For this calculation the mean center of pressure may be taken as being at 0.6 depth of float from inner edge for well-immersed wheels. The floats of a wheel should be so proportioned as to maintain practically uniform rotative speed, and by use of the graphic method this result can be secured.

The float pressure diagrams being laid out for the proper speeds of ship and wheel, the rotative forces acting on the crank pin are to be laid down on a polar or other diagram, and the separate float areas so trimmed that their resisting moment balances the crank effort at all points of revolution, a uniform rotational velocity will result.

Wheels having floats fixed at an angle (with the radius, or with the thwartship line, or with both) are readily analyzed by this method, the only modifications being the finding of the resultant angles between float face and line of motion, and the resolving of the twisted lines of force into their proper components in the fore and aft plane.



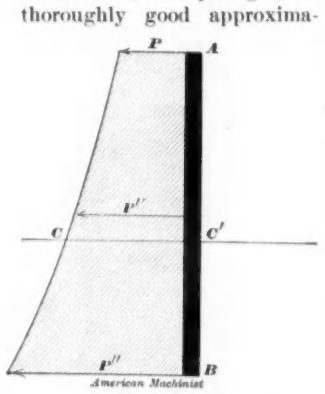


Fig. 2 (c)

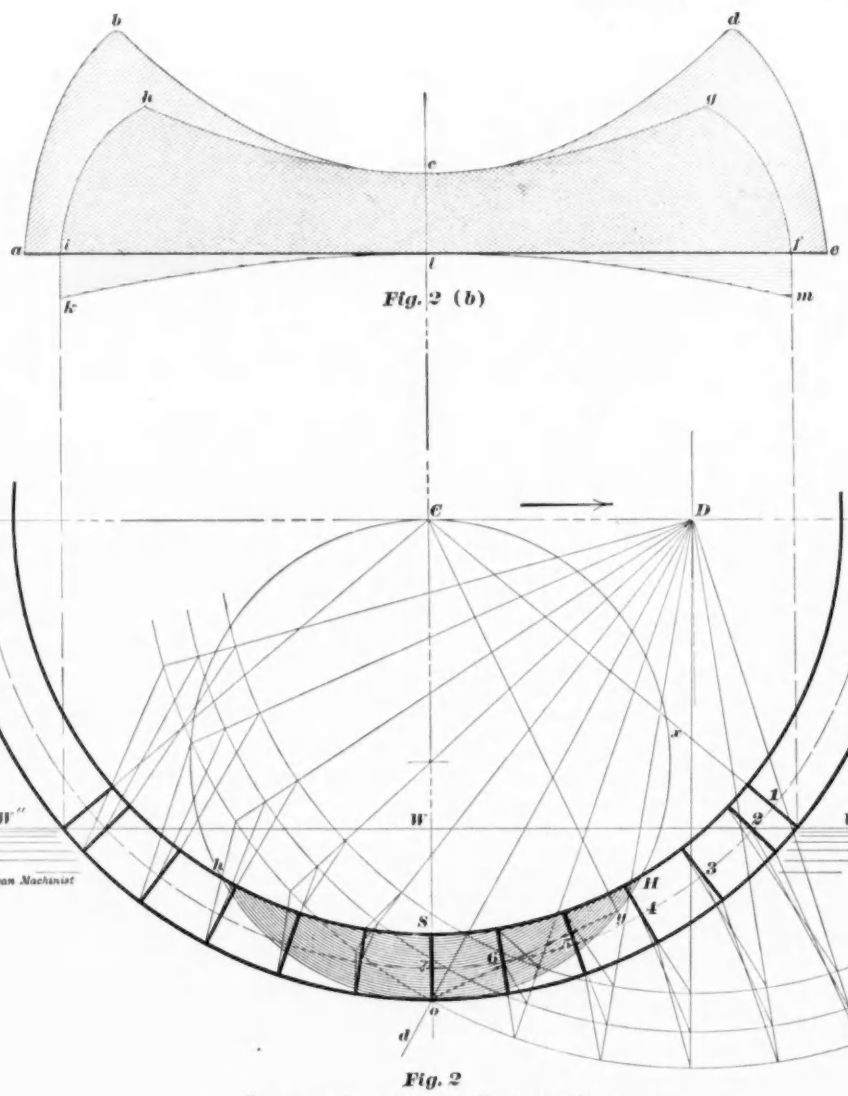


Fig. 2

GRAPHIC ANALYSIS OF PADDLE WHEELS.

The Cotton States and International Exposition.

Matters have so far progressed with the Cotton States and International Exposition (to be held at Atlanta, Ga., September 15th to December 31st) that its success seems at least reasonably well assured. Mr. J. H. Allen, who is chief of the Department of Machinery, stated in conversation the other day that he was meeting with every possible encouragement and assurance of co-operation from machinery builders, and expected to have exhibits from some leading American tool builders, and others who did not make exhibits at Chicago. Machinery Hall, at Atlanta, will be 100x500, with a trussed roof, dispensing entirely with posts within the floor space. All machinery will be belted up, and in position to run, no dead exhibits being allowed. Such machines as can be belted from below will be so belted, while machine tools, etc., that cannot be so belted will be placed under a structure at the side of the hall, supported by a lattice work designed primarily to stiffen the outer walls of the building, this structure supporting the necessary countershafts, etc.

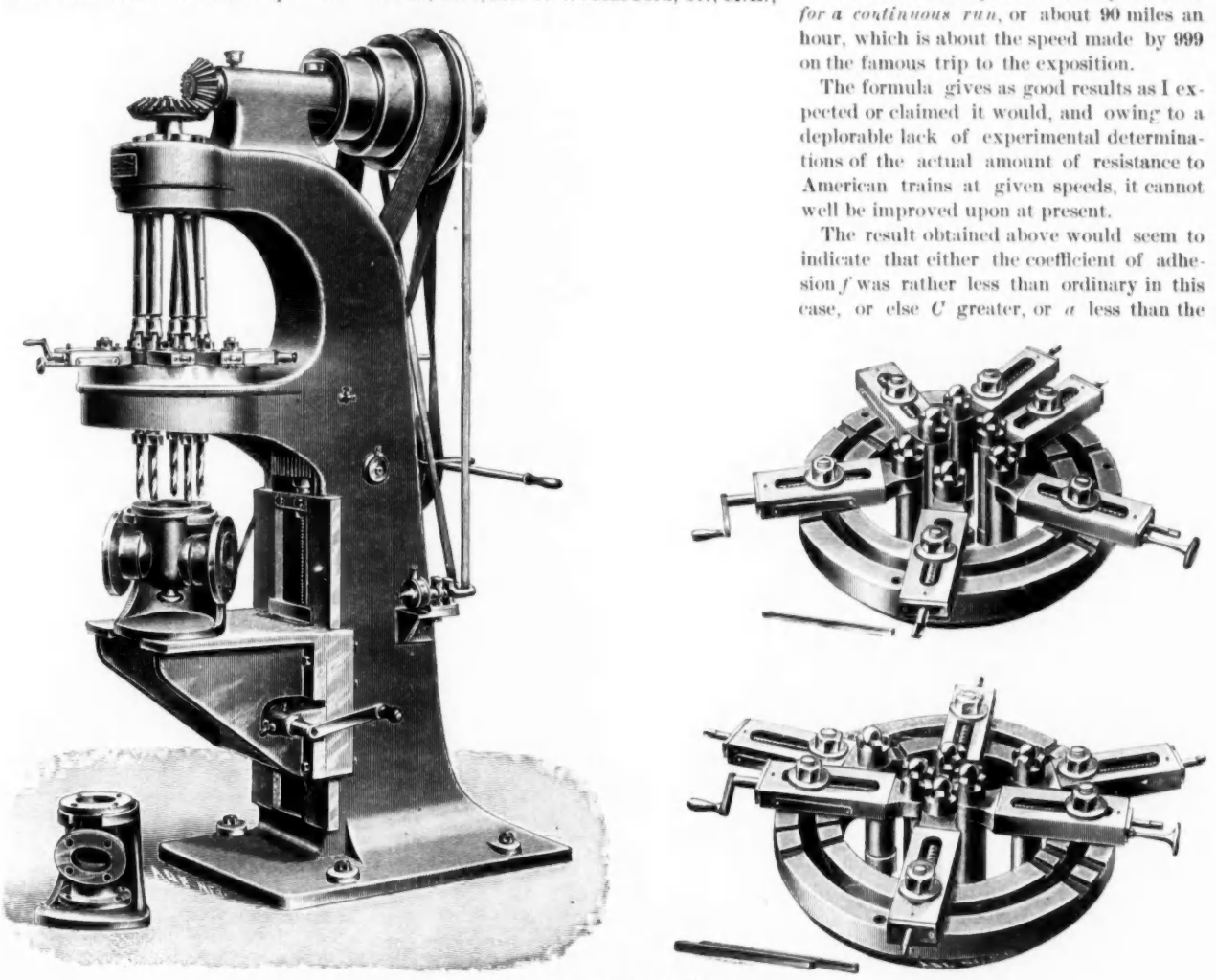
There will be sixteen water-tube boilers, from eight different builders, and these will carry steam at from 125 to 140 pounds press-

ure for power. Four carloads of logs will be received every day, and these will be sawn, dried and worked up into finished flooring, siding, and other forms in the sawmill, and by the other woodworking machinery exhibited.

Multiple Spindle Drilling Machine.

The accompanying illustrations are of a multiple drilling machine and drill holders manufactured by Messrs Habersang and Zinzen, of Düsseldorf.

In this machine the drill spindles proper are driven by clutches fitted with ball joints, and the intermediate sections have spiral springs for taking up the backlash (resulting from wear or other cause) thus eliminating any trouble with the drills as they go through the work. The spindles being vertically fixed, a screw-raising and lowering gear is provided, and is driven by a belt as shown in the cut. The drill holders, shown separately, have slots, radial or otherwise, or are made without slots for other than standard spacing and the drill guides bolting to the rings can be readily adjusted for any radius or angle. These drilling machines are made in various styles, some of which were shown at the Antwerp Exhibition.



MULTIPLE SPINDLE DRILLING MACHINE.

Rules for Engine Proportions.

BY F. A. HALSEY.

The admirable series of articles by Mr. Kent has demonstrated as nothing else could have done, the general unreliability of existing formulæ for engine proportions, and tempts one to repeat the remark made long ago in your columns that "the rule of thumb is a pretty good rule if the user thereof has a good thumb." The fact is, and it is time it were recognized, that all that mathematical analysis can do in these matters is to give the *form* of the desired formulæ, and any attempt to determine the various constants, factors of safety, etc., from a preconceived idea of the requirements, is futile. The only way of arriving at values for such constants is by consulting and averaging successful experience. A fundamental error of conception is involved in introducing a factor of safety as such at all. Bridges and roofs are designed to carry their loads with safety, and that is all that is required of them. The deflection under the load, while a matter of interest, is of very slight practical moment, but in machine construction the deflection is an all-important question. In other words, the proportioning of parts in machine design is not so much a matter of strength as of stiffness. Not, of course, that the parts should not be strong enough to carry their loads, but that the mere capacity to do this is not usually sufficient for successful operation. Not many shafts break from lack of strength, but a great many of them run hot because of insufficient stiffness. In point of fact, the factors of safety in many machine parts are so great as to be almost ludicrous if considered as such, but considered as factors of stiffness their magnitude becomes rational and clear. In some machine parts the question of stiffness is of relatively small moment, and in such the factor becomes reduced to a figure where it may with some reason be called a factor of safety, but in others where rigidity as near absolute as possible is desired, the factor introduced is so great as to lose all semblance to a factor of safety. Considered in the usual manner such differences are simply anomalous, and from no point of view, except the one presented here, can they be explained in a rational manner.

Is it not strange that among all that has been written on engine proportions so little should have been said about the frame? I am not aware of any author who has made any examination of this member or offered anything intended to guide the designer in determining its proportions. Considering the great variety of types of frames, no general treatment is possible, but one type at least—the Corliss—is susceptible of easy examination and comparison. I have quite a number of data on this subject derived from measurements taken from engines of different builders, and give below a few representative selections. The engines measured were from builders located in various parts of the country east of the Mississippi River. Four builders are represented in the table, all of the front rank. Their names are not given for obvious reasons. All frames included are of the Corliss type, either Simon pure or slightly modified. The method of comparison is to compute from the measurements the number of square inches in the smallest cross-section of the frame, that is, immediately behind the pillow block, also to compute the total maximum pressure upon the piston, and to divide the latter quantity by the former. The result gives the number of pounds pressure upon the piston allowed for each square inch of metal in the frame. This, while not the actual strain upon the metal, is strictly comparative and that is all that is required for the purpose.

Size of engine.	Lbs. per sq. inch of smallest section of frame.
10x30	217
12x36	248
18x42	278
24x48	360
24x48	395
28x48	575
30x60	350

It will be observed that speaking generally the strains increase with the size of the engine and that more cross-section of metal is allowed with relatively long strokes than with short ones, both of which are as we should expect. Other data of a more miscellaneous character show loads of about 300 pounds on short stroke engines of about 10 inches diameter of cylinder, while one memorandum of a 32-inch engine which has been running for many years without any indication of weakness gives a strain of 667 pounds.

From the above I have formulated the general rule that in engines of moderate speed, and having strokes up to one and one-half times the diameter of the cylinder, the load per square inch of smallest section should be for a 10-inch engine 300 pounds, which figure should be increased for larger bores up to 500 pounds for a 30-inch cylinder of same relative stroke. For high speeds or for longer strokes the load per square inch should be reduced in accordance with that final resource in all engineering—good judgment.

The above data are meager and the resulting rule is not sufficiently definite to satisfy the overnice in such matters. They are offered for what they are worth, and in the hope that they will call out the contents of other note books.

How would these figures look if reduced to factors of safety? Simply absurd, but as factors of stiffness they are intelligible enough. There could be no better illustration of my remarks on this topic than the above table.

LETTERS FROM PRACTICAL MEN.

Train Motion and Resistance.

Editor American Machinist:

In the AMERICAN MACHINIST for December 20, 1894, Mr. C. W. MacCord, Jr., M.E., applies my formula for the maximum speed of a train to the Empire State express, and assuming a working boiler pressure of 180 pounds, he compares the horse-power which he calculates would be actually developed by the locomotive running at 90 miles an hour with the horse-power necessary to overcome the resistance given by my formula, and shows an apparent error of about 21 per cent. in the result given by the formula for this particular case.

But to what is this error due? Either to a misconception of the principles on which the formula under question is based, or to the use of experimentally determined constants, which, while representing as nearly as possible the general conditions of train resistance at the time the experiments were made, do not *exactly* apply to the special and somewhat extreme case he considers.

But no error is detected in the derivation of the formula of my original article published September 27, 1894, and to show the effect of the experimental factors on the result given by the formula I will apply it to finding directly the maximum velocity attainable by the above train.

According to the specifications given in the *Scientific American* in 1893 for engine 999:

Working boiler pressure = 190 pounds per square inch.

Weight on drivers = 84,000 pounds.

Speed on trip to exposition = 86¾ miles per hour. The other proportions being as given by Mr. MacCord, and the formula is:

$$\text{Maximum velocity} = \sqrt{\frac{f\,L - a\,W}{C\,W}}$$

$$= \sqrt{\frac{K}{C\,W}} = V, \qquad (3)$$

f, a and C are constants whose value was previously given, L = the weight on the drivers, and W = total weight of the train. The velocity is given in feet per second. We have then $K = [0.222 \times 84{,}000 - \frac{1}{240} \times 576{,}000] = 16{,}591$, and $V = 907.8 \times \sqrt{16{,}591 \div 576{,}000} = 154$ feet per second, or 105 miles per hour.

But as I stated in my article, the train *approaches but never quite reaches* this maximum velocity. Under the rather uncertain conditions of the track and friction for this train, probably not more than 85 to 90 per cent. of this velocity could be depended on *for a continuous run*, or about 90 miles an hour, which is about the speed made by 999 on the famous trip to the exposition.

The formula gives as good results as I expected or claimed it would, and owing to a deplorable lack of experimental determinations of the actual amount of resistance to American trains at given speeds, it cannot well be improved upon at present.

The result obtained above would seem to indicate that either the coefficient of adhesion f was rather less than ordinary in this case, or else C greater, or a less than the average values which I have used. If, however, we knew the exact values of these constants, so called, for given conditions, we could determine the maximum velocity of a train exactly, except for a very slight error due to assuming that atmospheric resistance varies as the square of the velocity.

The writer hopes to extend the table of train resistance calculated from the formulæ (1) and (6) in the issue of September 27, 1894, by calculating the resistance for different values of a and C, so as to permit the user of the formulæ to adopt the constants best adapted to a given case; but the limited space for the above article would permit only of the most general consideration of the very broad subject of the theory of train motion.

R. E. HORTON.

The Hindley Worm—The Parkhurst Rod Feed.

Editor American Machinist:

In your issue of December 27th you published an article regarding a worm-driven shaper and say that the worm and worm gear are of the Albro-Clem construction. Without any intention of detracting from Mr. Albro's reputation as an inventor of this Hindley worm or screw, I wish to say that the worm mentioned was invented by an English engineer over a century ago and is known as the Hindley screw. Messrs. Morse, Williams & Co. have bought several of our machines for cutting this worm and worm gear, displacing those made by themselves. I wish to put the public right

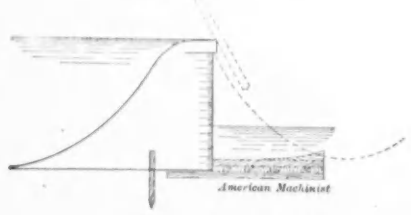
on this matter (although there are very few engineers who are not posted on the subject) and give credit to the inventor, even if he has been dead a hundred years. We, among others, are making this worm and gear which everybody has a right to do.

In the same issue you published a cut and description of an English turret lathe. You mention that the rod feed is what is known in the United States of America as the Parkhurst feed. Here you are wrong. It is identically the Brown & Sharpe rod feed, in which a weight is used to force the rod through the spindle. This was invented and introduced by the B. & S. Mfg. Co. before the "Parkhurst" wire feed. The Parkhurst rod feed, which we make exclusively, dispenses with the weight and carries the rod forward with a positive motion.

PRATT & WHITNEY CO.
F. A. PRATT,
President.

[Some time since during a conversation with Mr. Albro he gave me his reasons for dropping the name Hindley from the worm gearing made by him. I will not trust my memory to give these reasons, but have asked Mr. Albro to give them if he wishes to.

As to the rod feed, our description of it as the Parkhurst "except that a weight is used to bring the rod up to the stop" exactly fits the Brown & Sharpe feed, though we failed to recognize it in this instance.—ED.]



Vibrating Waterfalls.

Editor American Machinist:

Mr. James Hobart gives an interesting account of a vibrating waterfall, as illustrating vibrations coming from waves.

The writer has heard of one similar near Diamond Hill, R. I. This waterfall vibrates only when the wind blows in a certain direction—down stream. At such times the water goes over the dam in waves, as illustrated by Mr. Hobart, but unlike the fall he mentions, the vibrations are there with either high or low water.

The waterfalls that give most annoyance, however, are those that cause air vibrations at all periods, and are the worst at high water. They are vertical dams closed at the ends. The cut shows the cross-section of one of this kind. This is on the Housatonic River, about fifteen miles from Bridgeport, Conn. The dam, with apron as originally constructed, is shown in the full lines. The vibrations from this fall, which was about twenty feet high, would shake the doors and windows within the radius of a mile and a half to two miles, and when the water was high was most annoying. This dam withstood freshets for several years, but during one freshet the ice broke up, and huge cakes of it would pause on the crest, as shown by the dotted lines, and then go straight down on the apron until that was broken away, and the portion built under the dam loosened the latter, which was washed away.

The dam was rebuilt with a curved apron, as shown by the long dotted lines. There is no trouble from vibration with such construction.

Mr. Hobart says the vibrations can be stopped by building top of the dam in spots. Mr. E. N. Evans says that pieces of drift wood will also stop it. Anything that will admit of a free circulation of air back of the fall will stop it. The most durable thing would be two or three stone piers built into the top of the dam sufficiently stout to withstand floating ice, and if such are spaced across the dam at intervals of, say, seventy-five feet, any noticeable vibrations will be prevented.

As I remember the dam to which I think Mr. Hill alludes, there is a ledge about one-quarter of the distance from the west end. If this is correct, the vibrations are not as great as they would be if the dam had an even crest and fall for the entire distance.

Waterbury, Conn. W. E. CRANE.

A Talk to "Practical Men," By One of Them.

Editor American Machinist:

In your issue of January 24th is an article by Professor Wood, in which he makes a special point of making very plain the difference between weight and mass.

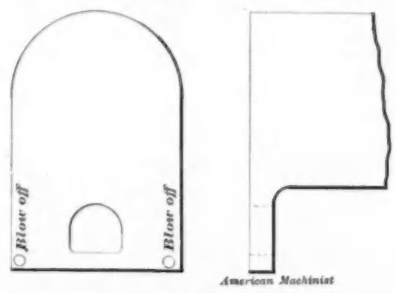
It is sometimes of considerable importance to practical men to be able to clearly distinguish between the two, but the trouble with this article of Professor Wood's is that too many of us will look through it, see things in it that look like algebra, and immediately skip the whole thing with perhaps a muttered imprecation at the editor for "printing such stuff that nobody can understand."

But let us examine this matter a little, because, of course, it is too bad for us to miss a thing of very considerable interest and value to us simply because we think we cannot understand it, when in reality we can easily understand it if we only think so.

In the first place, on looking over the article we find that there is a good deal of it that is very clear and very interesting before we come to what some are in the habit of referring to as the "x plus q business," and this it will be well to read and think over in any event. Then, when this has been done, it may be well to reflect that the formulæ used by the learned professor, though they may look formidable or even appalling to some of us, are really very simple ones—so simple that anyone can readily understand what they mean, and, having once understood them, will be far less frightened at similar ones in the future.

Now, although most of us so-called practical men know very little about algebra, we, of course, know some things about arithmetic, and can multiply and divide, add and subtract. With this stock of knowledge at our command, let us examine the professor's first formula. It must be acknowledged that one arbitrary symbol or sign can indicate a certain quantity as well as another different symbol or sign, if we only understand what it means, and in every case Professor Wood tells us just what the letters he uses in his formulæ stand for. Bearing this in mind, we could write his first formula thus, mass $= \frac{\text{weight}}{32.2}$. We know, of course, that when two Arabic figures, or any other two symbols, are written one above and the other below a horizontal line, the quantity represented by the upper one is to be divided by the quantity represented by the lower one, and bearing this in mind, we at once see that the formula means simply that the mass of any body is equal to its weight in pounds divided by 32.2. In the same way the next two formulæ are readily understood, and, knowing that if two letters or symbols simply follow each other without any sign between them, they are to be multiplied together, we see that the fourth formula means simply that force (F) equals mass (M) multiplied by velocity in feet acquired at the end of the first second, or acceleration (a), and that either of these is equal to the weight of a body (W) divided by 32.2 (g) multiplied by acceleration (a). Then, our plain every-day arithmetic tells us that when any number, such, for instance, as 4, is written with a small figure 2 attached, thus 4^2, it means that 4 is to be squared or multiplied by itself, and is, therefore, really equal to 16. The same is true of the letters thus written by the professor, *i. e.*, each quantity so represented is to be multiplied by itself.

Of course, this explanation may, to use a slang expression, give "that tired feeling" to those who know all about algebra; but then most of those who know all about algebra also know the difference between weight and mass, and do not so much need to understand Professor Wood's article, and this is not written for them, but for the others (just as smart in their particular lines of work), who need light on the difference between weight and mass, and are apt to get needlessly frightened when they see what looks like algebraic formulæ, even when the formulæ are so simple as to be readily understood by anyone: as they are in this instance. S. T. FREELAND.



Criticism of a Boiler Water Front.

Editor American Machinist:

In your issue of January 17th, page 42, is an illustration of a water leg attached to a tubular boiler, that I consider is liable to give trouble from two causes.

The circulation in a tubular boiler is something as follows: The larger part of the evaporation is in the front end, where the fire is hottest, and the circulation is up to the top of the water, and to meet this the water rushes along the bottom from the back end, under certain conditions, depositing its sediment over the fire sheets, causing "bagging." This it is almost certain to do if the boiler current meets the feed over the crown sheets. Also sediment will fill in on the flat space shown in the design over the fire door, and induce leaks.

The top of the door should be made round so that loose dirt can find no lodgment.

The feed entering at that point will cause corrosion there, which will be very difficult to detect.

The outline sketch here shown is Rheutan's patent water front, which, it will be observed, is not open to the above objections, particularly as the feed enters in front above the tubes, and is carried to the rear in a pipe as recommended by insurance companies.

These Rheutan boilers have pretty thoroughly demonstrated the strong circulation existing along the bottom of a boiler, from the back to the front end.

An engineer told the writer that he accidentally left his 2-foot rule in the back end of one of these boilers, and the next week when opened, he took it out of one of the hand holes in the water front. There are cases where it is claimed steel tools have been carried over the same course. It is also said that these boilers are kept as clean with the blow-offs in the water front as ordinary tubulars are with bottom blows at the rear.

Repairs are now being made on a set of Corliss upright boilers that collected sediment over the doors, as will be the case with the design you illustrated, and the stay bolts were in the way, so that the place could not be reached. New hand holes have now been cut over the doors.

W. E. CRANE.

Watch Pallets—Small Motors.

Editor American Machinist:

Mr. Booth, in his letter to AMERICAN MACHINIST of December 13th, complains of the American method of fixing watch pallet stones. The English method is certainly more mechanical, stronger and durable, but the U. S. method lends itself to such an accurate and ready adjustment, that for factory work, where rapid production combined with great accuracy is needed, no other method is likely to find favor. The U. S. watch escapement is much more closely adjusted, and more free from inequalities and errors than the majority of English lever escapements are. Mr. Booth's watch does not go so well as formerly because the pallet stone was not properly refixed. If I knew where a private letter would find Mr. Booth I might tell him where he might be able to get his watch restored to its former good timekeeping.

The little gas engine to which Mr. Booth refers, reminds me of a larger one, also vertical, with the crank and connecting rod encased like the Westinghouse steam engine. There is only one valve—the governor valve—on this engine, but it is not an Otto cycle, as it receives an impulse every revolution, and this engine is made by Day & Co. Will Mr. Booth kindly give me the name of the maker of the ¼-horse engine he speaks of?

England. B. H. J.

The Proper Method of Projection.

Editor American Machinist:

I have just noticed Mr. H. L. Hund's letter in the AMERICAN MACHINIST of January 10th, headed "The Proper Method of Projection."

It seems to me that his talk on the subject is entirely devoid of argument, either against the method which he wishes to attack, or for the one he would advocate. He has attempted, by means of many absurd assumptions, to ridicule the way he does not like, and make it appear that all who follow it are very foolish persons indeed.

It is scarcely worth while to notice what was said, in detail, for no one will be persuaded by mere ridicule based on preposterous suppositions. It is idle to talk of having "in order to draw a plan view" of the anvil, "to place a board beneath it"; of sighting down and marking off points, and of needing "to be able to see through the anvil, and mark off on his board those portions over the base," to say nothing of the stepping back an infinite distance, etc. Does not Mr. Hund see that the same ridiculous things can be said, equally as well, of *his* way? If his object, unlike the anvil, had been bigger at the top than at the bottom, would *he* not have had to *see* through "a good deal of solid iron" to tell anything of the shape of the lower part? And then, too, if "he does only what he does every day of his life when he looks through his room window at an object on the other side of the street," and holds his "transparent plate" over, or before his anvil, and draws thereon, he *does not get* a correct drawing, but a *perspective*, which is not what he wants. He too must step back at an infinite distance, also needing "an unparalleled expansion of his limbs," and, likewise, "must be gifted with remarkable eyesight indeed" to see so far.

Mr. Hund has evidently been trained in the one way, and, like many people, feels sure there is no way but *his* way. It is natural for one to get to feeling so, when he knows some one way well, and is not familiar with any other.

An attempt at a rational discussion of these two methods would hardly be profitable, as any such attempt is almost sure to prove a failure, ending in useless quibbling. However, it should be known that there are sufficient reasons for the adoption of the method which Mr. Hund attempts to ridicule, in preference to the other.

As far as the majority of mechanics are concerned, and a great many draftsmen as well, who have had little mathematical training, it is not necessary that any scientific explanation be given of the method of representation they use. It is impossible to give an explanation of the theory of either method which will seem to them altogether sensible. It is useless to talk to many of "deriving projections on planes of indefinite extent," and of "assuming the point of sight at an infinite distance, so that the lines of sight shall coincide with the lines of projection," etc. For all these persons it is sufficient and best to explain the projections as simply *views* taken from the several directions. This can be done clearly and satisfactorily to the most untrained mechanic, or to any intelligent boy.

And then the question is just one of arranging the views on the drawing, when, for the purpose of merely representing objects, it is really of little consequence whether the plan is above the elevation, and the left end view to the left of it, or otherwise. For one can become accustomed to either arrangement, and when once familiar with it, the whole matter seems so simple to him that he cannot believe that any other way could possibly be so easy. In both methods the plan, elevation, and end views are *projections*, and are exactly

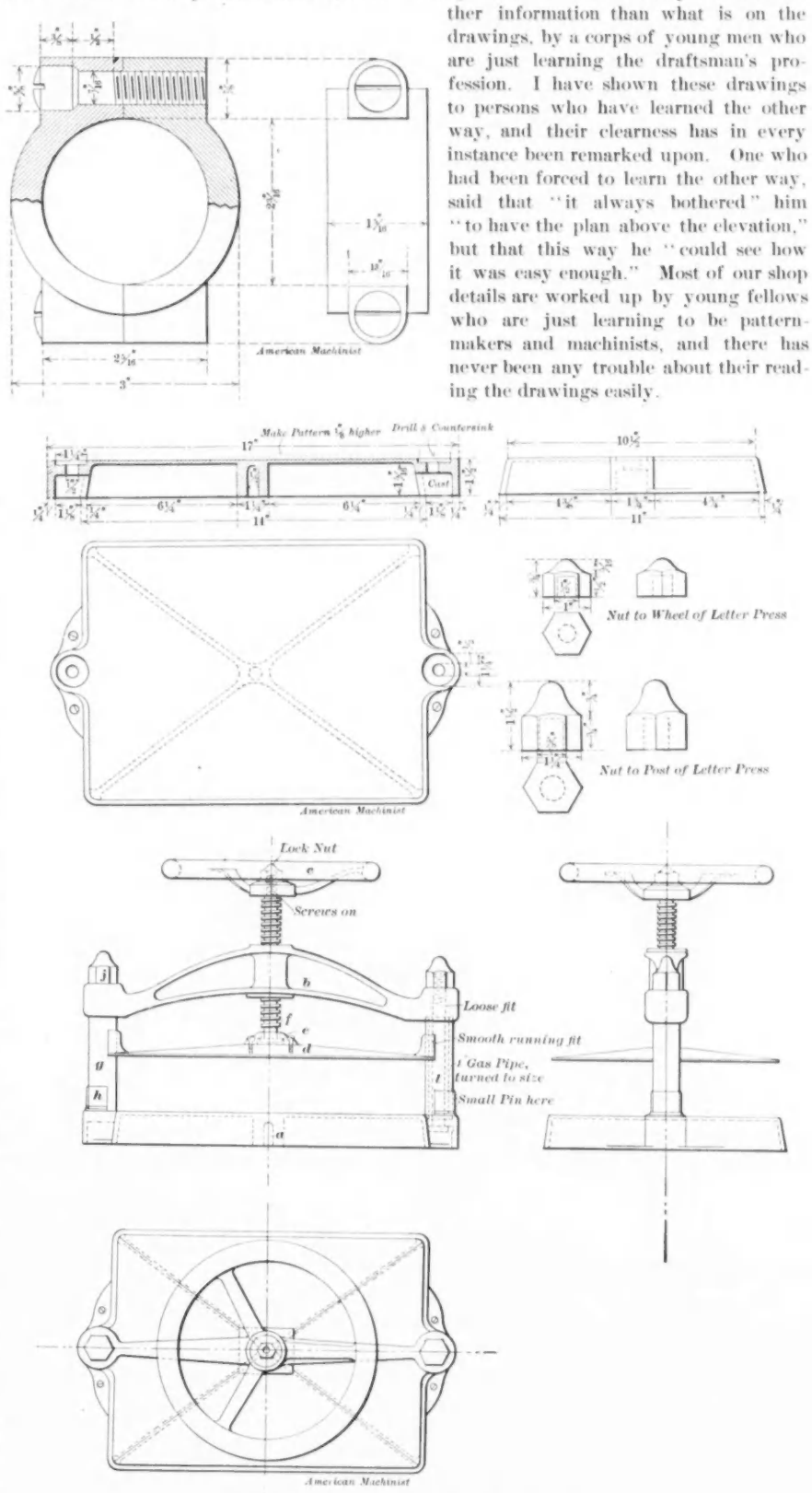
alike respectively, so that in both the projections may be explained as views, in which case it is immaterial whether the views are arranged in the one way or the other. One way, however, should unquestionably be adopted and adhered to. And evidently, now, the adoption of this way should be governed by some other consideration than merely the position of the views on the paper. To those who have become accustomed to placing the elevation first, and below it the plan, and to the right of it the view as seen from the left, this *does* seem the natural and best way, and undoubtedly to those who have become accustomed to the other way, that seems the best possible. But for this very reason, that either way seems the best when once learned to the exclusion of the other, something else should decide the matter.

Now, for those who do possess a knowledge of the science from which all our ideas of projection drawing are derived, an explanation of the method of representation adopted must be provided, based upon the principles of that science. Projection drawing *is* an *exact* science, founded upon mathematical laws, it being directly an application of descriptive geometry. Its methods should, therefore, be in accord with the conceptions, and the principles and practices of the mathematics upon which it is based. Other things being equal, as they evidently are when it is a question of merely representing objects, that method should be adopted and used which is most rationally explained by the laws of the science of which it is one branch or application.

Now, in descriptive geometry two mathematical planes of indefinite extent are conceived, intersecting each other in space at right angles, the one plane vertical, and the other horizontal. On these two planes all mathematical problems can be, and are represented, by means of projections and traces. For special conditions a third plane is used intersecting the two first assumed, perpendicularly. The two planes of projection, or co-ordinate planes, as they are called, form four dihedral angles, dividing all space into four equal parts, in one of which the eye of the observer, or "point of sight" is supposed to constantly be. This is the *first angle*. In this first angle naturally, all problems are assumed as far as possible. Whenever the nature of a problem or certain peculiar conditions require that part of the figure in space shall extend back into the second angle, or down into the third or fourth, it is always considered that the treatment of the problem is complicated thereby. It would be considered an exceedingly strange and unreasonable proceeding to willfully assume any problem in one of those angles, even so simple a problem as that of finding the angle which a line in space makes with the horizontal plane of projection.

How unreasonable, then, is it to assume such a machine as, for instance, an engine lathe, or a universal grinder, in the third angle, or in any but the first angle of the two planes. The machine as conceived in the mind of the designer, with all its intricate lines, and its many surfaces of varied degrees of curvature, is more complex and difficult of representation than the problems of descriptive geometry. What reason can there be, then, in insisting on the use of the third angle for such work, when this angle is used as little as possible in the descriptive geometry, the science which includes all the applications the draftsman employs, for the good reason that it is recognized that so doing complicates the problem unnecessarily? When the third or profile plane is used it is passed to the right of the object, then revolved backward to the right into coincidence with the vertical plane, bringing the second elevation, which is the view from the left, to the right of the first elevation.

In many instances problems are met in designing which demand solutions as elaborate and difficult as many which the student is called upon to work out in the study of the pure science. Whenever there are any mathematical operations necessary on the drawing, as there frequently are, such as the revolution of figures, and working out of intersection and developments, the use of the third angle is a proceeding directly at variance with all the training which the draftsman must have acquired in order to be able to perform these operations. Then the third angle arrangement becomes confusing, and as a natural result it is found, as a rule it may be said, that draftsmen who do use this arrangement exclusively are not competent to deal with the features of designs calling for a little descriptive geometry. So why should not the arrangement of views be universally used which conforms



THE PROPER METHOD OF PROJECTION.

to the uniform, rational practice of descriptive geometry?

I am well aware that the method which Mr. Hund favors has many advocates, some of whom are among our authorities on drawing, but nevertheless, it is going too far to say, as one writer did in a recent book on "Mechanical Drawing," that it is the method "required by all good practice." If anyone really believes that it is actually "required by all good practice," that the other method cannot be used satisfactorily for drawings of complicated machinery, or for designing, he should examine the drawings we have in our drafting room here, which we should be pleased to show anyone interested. There are machine shop drawings of every description, drawings for innumerable small articles, details of complicated machines made on standard sizes, tabulated and indexed in regulation form, and designs for a number of complete machines, among which may be mentioned a universal twist drill grinder, a drill press, a treadle lathe, a shaper, a large wet grinder, etc., all of which are designed to be built, too—not merely for the sake of drawing up something. All of these drawings are made in accordance with what we consider the natural way, and we are willing to leave it to anyone who can read shop drawings to say if they are not *clear*. The designs are clear enough to be detailed correctly without further information than what is on the drawings, by a corps of young men who are just learning the draftsman's profession. I have shown these drawings to persons who have learned the other way, and their clearness has in every instance been remarked upon. One who had been forced to learn the other way, said that "it always bothered" him "to have the plan above the elevation," but that this way he "could see how it was easy enough." Most of our shop details are worked up by young fellows who are just learning to be pattern-makers and machinists, and there has never been any trouble about their reading the drawings easily.

I will send herewith a drawing of a letter press made in accordance with the system we use. The press was designed by a young man who, less than a year ago, never had made a shop drawing of any kind. This is his first attempt at a design. I will send also one of his details of this press, and some odds and ends of shop drawings which we happen not to be using just now. They are not without defects by any means, but these are minor errors and oversights to be expected of young men just gaining their first experience. They will serve at least to illustrate "our way."

It will be noticed that we do not draw in *all* the invisible lines, but only just so many as will be helpful to the detailer or shop men, as the case may be. Sections are used wherever they will simplify matters. Our rule is, on designs to show the machine complete, whenever possible, putting in the needed invisible lines, occasionally using a section or a partial section, if the character of the machine makes it best to do so; and on details, to make use of sections wherever they will render the form more clear, but not to section a piece needlessly, for "cross-sectioning" consumes time, and unless it shows something better than can be shown any other way, is confusing on the drawing.

The three or four views are not invariably arranged according to the system, as sometimes there are special reasons for placing them differently, but in all such cases they are plainly lettered "Plan," "View From Left," and so on. And it is not always necessary to have all three views, or four. Sometimes plan and elevation are sufficient. Often the plan may be dispensed with, and the elevation and one or more end views used. Judgment must be used, based upon careful consideration of *what the drawing is for*, remembering that a working drawing is to *show the workman what to make and how to make it*.

The system we use was not adopted without a consideration of others, and we hope no one will allow himself to become prejudiced in favor of one way or the other, blindly, but that he will consider impartially all views of the question.

W. K. PALMER.

Miller Manual Labor School, Crozet, Va.

A Question in Electrics.

According to an esteemed contemporary, high chimneys built of slag bricks are lighter and stronger than the ordinary type, and are absolutely proof against lightning "since slag is such a positive non-conductor."

A large American watch factory is to be established at Osaka, Japan. The capital stock is 300,000 yen, of which 150,000 have been subscribed.

Mr. S. S. Townsend, who was well-known in the machinery trade for many years and was formerly general agent for the Root's blowers in New York, died January 14th at his home in this city. His career in business was a long and honorable one, and he had many friends.

Mr. A. G. Fell, of Warrington, Fla., while in this city recently on business connected with the several electric and other enterprises in which he is interested, called upon us and discussed the general outlook of affairs in Florida.

Mr. Fell considers that there is every prospect of a revival of prosperity in the Peninsular State during the coming season, and his company is preparing for a large increase of business.

The Elm City Stationary Engineers' Association, of New Haven, N. A. S. E., No. 10, of Connecticut, has adopted a course of lectures on engineering matters, and a list of subjects to be discussed during the coming quarter has been forwarded us by Mr. W. H. Wakeman, the association instructor.

During the year some 300 questions will be considered by the members, and we infer from the quarterly list, as well as from Mr. Wakeman's letter, that the Elm City engineers have no intention of allowing their brothers in other sections to distance them in professional knowledge.

We have received from *The Tradesman*, Chattanooga, Tenn., a copy of *The Tradesman Annual*, No. 16. This is a book of 216 pages, containing contributions from many of the most eminent authorities in this country, dealing with the questions connected with the resources of the Southern States. The issue is virtually a standard encyclopedia for Southern industrial and cognate interests, and contains a list of over 5,000 of the chief industries in that section of the country. It is, of course, a very valuable publication for those who are interested in manufactures, especially in the South.

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☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Cheap Power From Niagara.

It is stated that two new companies in addition to the one now deriving power from Niagara Falls, will put in plants there, and will furnish power to industrial establishments in Buffalo. Prices as low as $2 or $3 per year per horse-power are talked of by one company which already controls a canal from which power for a number of factories is derived, the waste water falling over the cliffs. It is expected that by simply fixing pen stocks to the face of the cliffs, placing water wheels at the bottom and turning this waste water into them, about 30,000 horse-power will be available.

Though it is in our opinion almost certain that power cannot be furnished at the figures named, yet this question of cheap power is, of course, one which vitally interests manufacturers, and those who look only at the surface of things might suppose that manufacturers in Buffalo getting power at a cost of two to three dollars per horse-power per year, would have a very great advantage over those located elsewhere; but experience in similar cases, and so far at Niagara as well, does not bear out this view.

An engineer residing in the vicinity of Buffalo informs us that land suitable for manufacturing sites, and so located as to make the cheap power available, has risen in value from an average of about $300 per acre to about $3,000, as a direct result of the cheaper power. It is almost certain that if all the advantages now offered by this land for manufacturing purposes were to be carefully compared with its advantages before the cheap power was thought of, this difference in cost per acre would be a pretty accurate measure of the difference in advantages. Exactly the same principle applies to comparisons made between manufacturing plants located in Buffalo and similar plants located in Cleveland or elsewhere. If in each case the annual rental value of the land occupied, or the interest on its actual value be considered as a part of the cost of production (as it should be), it will, we think, be found that things are nearly balanced, *i. e.*, that whatever advantages a given manufacturer may have over another in the matter of cheap power will be balanced or nearly so by the cost of the privilege of using it; and this is one of the reasons why manufacturers in Hartford, Providence, Cleveland or Cincinnati need not especially fear the competition of manufacturers who get power at much lower cost elsewhere, unless the owner of the land upon which the factory stands (who may be also the manufacturer occupying it) is willing to ignore its value in making up his accounts; something which he does not usually do if he is wise.

British Light Railways.

The conservative element among our English cousins is greatly exercised over the proposal of the go-ahead portion of the community to grid the tight little island and also its near neighbor with what are known as light railways, which are intended to develop the outlying districts by placing them in communication with the main arteries of traffic.

As usual in all countries where anything in the shape of a transportation line larger than a toboggan slide is talked of, the champions of broad and of narrow gauge are out in full force vociferously expounding their views, and advocates of electricity, compressed air, gasolene, gunpowder, and other motors, are not behind in adding to the general excitement.

The progressive Englishman labors under serious disadvantages in the land of his birth by reason of the medieval ceremonies that hedge around and discourage every move that is made to advance material affairs, and the building of even a suburban trolley line becomes under prevailing conditions a very serious undertaking.

After a most exhaustive survey has been made by those who are willing to further the project, the promoters, who must be armed with certificates of good character setting forth their financial standing, and the fact that they are regular church communicants, present a memorial to the Lords and Commons, who, after a dignified period of delay, proceed to regularly bring up for debate, and table the measure for a stated number of rounds, until each acknowledged orator and party leader has placed himself aright before his constituents by "defining his position" in a speech of several hours duration.

At the end of these preliminaries, which are carefully adjusted to occupy at least one season's sessions of the governing bodies, it is politely intimated that there is not sufficient legal talent on the side of the petitioners to properly conduct the affair, and certain friends of progress kindly furnish the company with a list of such members of the bar as are noted for legal acumen, legislative "pull," and broad views as to the pecuniary value of their own services.

There being absolutely no loophole for escape, the wretched promoters mortgage their holdings to furnish retainers, and endeavor to cheer their drooping spirits with the thought that a great step forward has been taken.

But the end is not yet in sight by many a long and weary day; for, no sooner has the scheme reached this stage than the military awake, and, arising as one man, hotly protest against "hasty and ill-considered action."

The service journals point out that the new project is capable of giving aid and comfort to the nation's enemies, that possibly a corporal's guard of blood-thirsty foemen might be enabled to secretly land in the heart of the unsuspecting community, to become a menace to the lives and liberties of a free and proud-spirited people.

The blood-curdling legends of old days are raked over, and little children go trembling to bed filled with the stories of the times when dark and sinister Frenchmen, and Paul Jones and his worthy crew, were wont to appear mysteriously from out the fog and darkness on the coast, and stampede a beef creature in the sight of the innocent people.

Town meetings are held all over the kingdom, the Home Secretary is exhorted to interfere and prevent the threatened disruption of the Empire, the promoters of the railway are burned in effigy, and every yeoman sleeps with a broad axe for a pillow.

The Queen's Council now calls for the papers in the case, the celebrated ordnance map is taken from its jeweled casket of pearl and ivory, and spread upon the council table, and stern generals and grave admirals solemnly plot the proposed line to within the smallest fraction of an inch of antediluvian bed rock, and Trinity high water mark.

And so the affair drags along, and if purses and patience are sufficiently elastic the Charters and Grants may be forthcoming in time to be handed to the grandchildren of the original projectors as something promising a means of absorbing superfluous energy and spare collateral in the future.

Our transatlantic friends should note the way in which we go to work when we really believe that a public improvement is likely to advance the civilization of the age, and incidentally pay the stockholders as well.

The car of progress is not here allowed to be delayed by any sentimental notions either as regards national defense, or the alleged moral or legal rights of people along the proposed line of way.

The first question does not alarm our inland granger population in the least, and as to the second, our legislators scarcely consider themselves called upon to waste time in looking out for individuals who may be too careless to keep an eye on the moves of corporate bodies who are likely to encroach on their preserves.

After a hurried survey of the route a political boss of unlimited power and aggressive energy is properly "seen," his sympathies aroused, and his protection secured, and before the property holders along the line are aware that anything disagreeable is afoot, bills are rushed through the legislature in secret sesson. Then the books are opened, and ere the ink is dry on the first half dozen signatures, the smiling children of sunny Italy are turned loose with pick and shovel, the ground is torn up through field and thoroughfare, and the railway is an assured success—ready to be stolen by one of our "financiers."

Death of E. L. Maxwell.

Eugene Lafelle Maxwell, member of the firm of Manning, Maxwell & Moore, of New York, president of the Pond Machine Tool Co., of the Ashcroft Manufacturing Co., and of the Shaw Electric Crane Co., died at his home in Brooklyn, Saturday the 9th. Mr. Maxwell was born in Brooklyn, and was forty-four years old. He was very widely and very favorably known in machinery and manufacturing circles—as an honorable and courteous gentleman, and an excellent business man.

Charles W. Copeland.

On Tuesday night, February 5th, after a protracted illness, Charles W. Copeland, one of America's best known marine engineers, died at his residence, 151 Columbia Heights, Brooklyn.

Mr. Copeland was born in Coventry, Conn., in 1815, and came of engineering stock—his father owning an iron works in Hartford, Conn.—and after passing through the various branches, became superintendent of his father's business, in which position he designed and constructed various of the early steamers used on the sounds and rivers of the coast.

In 1836 he was placed in charge of the West Point Foundry, and while there built the engines of the U. S. S. "Fulton," the steamers "Utica," "Rochester," "Swallow," and others of note, besides the earliest American iron steamer, which plied on Lake Pontchartrain.

In 1839 the U. S. Government appointed him chief engineer of the Navy, and during this period Mr. Copeland designed and constructed the "Mosquito Fleet," used in the Mexican war, as well as such noted vessels as the "Mississippi," "Missouri," the iron side-wheeler "Michigan," for the lakes, the machinery for the "Saranac," "Susquehanna," etc.

After leaving the naval service, Mr. Copeland took charge at the Allaire Works, of New York City, and there built the engines for the "Pacific," "Baltic," the steamer "Panama," for the Californian line, the "Bay State," "Empire State," "Traveller," and also the "Harriet Lane," the U. S. Revenue steamer.

Mr. Copeland was the first supervising inspector of steamboats for the district of New York, and later was consulting engineer to the U. S. Lighthouse Board, many of the lightships being built from his plans.

While director and consulting engineer to the Norwich and New York Transportation Co., he designed the steamers "City of New York," "City of Boston," and "City of Worcester."

Mr. Copeland was a charter and life member of the A. S. M. E., and was known as a designer throughout the length and breadth of the land, his work being looked upon, both at home and abroad, as embodying the best features of American engineering practice.

Literary Notes.

THE ANIMAL AS A MACHINE AND A PRIME MOTOR, AND THE LAWS OF ENERGETICS. By R. H. Thurston.

In this book the first 36 pages are devoted to an introduction, in which are discussed the laws of energetics and of power production and utilization. A good part of this chapter is made up of the well-known laws, principles and formulæ relating to matter, force and energy. The next 47 pages are devoted to the discussion of the engineer's

views of the animal as a motor machine. In this chapter much of the matter has been gathered from investigators and engineers who have made this subject a special study. Tables are given showing the work done by animals, the effect of the variation of speed on their working power, and the influence of the various conditions, favorable or unfavorable, upon their performance. The uses of food are made the subject of investigation, and the researches of other authorities are referred to and their results noted. The remaining chapter of 13 pages is devoted to final deductions. The principal aim of the author has been to gather available information and present it in a compact form for the use of engineers, but however valuable the contents of the book may be its value is much impaired by the omission of an index. The table of contents is not handy enough for the busy engineer.

The book is published by John Wiley & Sons, 53 East Tenth street, New York. Price, $1.00.

PRACTICE AND THEORY OF THE INJECTOR. By Strickland L. Kneass C. E.

This is a clear and practical work, in which the principles governing the design of injectors are stated in plain language, in such detail as will enable those interested to readily acquire a sound knowledge of the device.

The proper form and dimensions of the passages for maximum efficiency are explained, and experimental data of the effects of departing from standard outlines are given.

The book is published by John Wiley & Sons, 53 E. Tenth street, N. Y. City. Price, $1.50.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(61) G. C., Kokomo, Ind., asks: Which is the best atomizer for crude oil used in connection with steam or compressed air? *A.*—We must decline to recommend any patented device in preference to another. Questions of this kind should be submitted to a reliable and experienced mechanical engineer.

(62) T. B., Greenville, Ala., writes: Kindly advise me if there is any known way of jacking up a locomotive and turning off the tires with the power furnished with its own boiler. *A.*—No. The wheels would have to run too slow for the power which the cylinder of the same locomotive can furnish, neither is it practical to run the axles on the oil cellars while turning the tires.

(63) J. W., Brighton, Mass., writes: Kindly inform me if involute teeth can be used for internal gears, and if not, why not? *A.*—Yes, provided there are at least twelve more teeth in the internal gear than in the pinion, otherwise the internal teeth are liable to interfere with those on the pinion, and will need to be "doctored" or rounded over until they will pass. It is also advisable that the pinion should have not less than 30 teeth, otherwise the teeth are liable to be weakened at the root.

(64) J. C. E., Yonkers, N. Y., writes: Kindly inform me where I can obtain a book pertaining to patternmaking. *A.*—"Machinery Patternmaking," by P. S. Dingey, published by John Wiley & Sons, 53 East Tenth street, New York, is a good book. Most of the matter in this book was published in our columns. Of course, there are other good books treating on the same subject which you can examine on the counter of any dealer in scientific or technical works, and select such as will answer your purpose best.

(65) M. N., ——, writes: I have two iron truck wheels 39 inches diameter to make, which are to carry 4,000 pounds over a rough road. I propose to make the wheels of boiler plate and intend to use two flanged heads ¼ inch thick riveted to a tire ½ inch thick and 8 inches wide; the hub is made of cast-iron and riveted to the heads. Will these wheels be strong enough for the given load and running over a rough road? *A.*—Yes; but we should not put the parts of the wheels together as shown in your sketch; we should turn the flanges of the heads outward instead of inward, and countersink the heads of the rivets in the tire. We should also place a ferrule between the heads on the four tie rods shown on your sketch. We cannot express an opinion on the strength of the hub, as none of its dimensions are given.

(66) C. A. C., Buffalo, N. Y., writes: Please answer the following questions relating to hydraulic rams. Is it necessary to have a valve in the drive pipe so as to regulate the pressure? *A.*—We have not seen a valve used for this purpose, and have some doubt as to its advantage, the pressure depends on the hight of water in the spring or source of supply. A gate may be used with advantage at the inlet of the drive pipe to regulate the supply of water. 2. Is there any reason why a drive pipe should not be brought down on a straight line instead of running it zigzag, which has been done in some cases? The claim is that the momentum is too great when the drive pipe is straight. *A.*—We see no good reason for making the pipe zigzag. 3. How is the pressure regulated on the waste valve now that the old-fashioned hinge valve with arm and weight are not used? *A.*—A suitable weight is placed on the valve.

(67) J. R. G., Richmond, Va., asks: What is the highest temperature which a boiler feed pump can raise and deliver to the boiler? Also, why does a pump fail to work after the feed water has reached a certain temperature? *A.*—The temperature of the feed water which a pump can handle depends much on the general design of the pump. A pump specially designed for feeding hot water can handle water at a comparatively high temperature; but hot water will impair the efficiency of the pump, for the following reason: Hot water will throw off a vapor which will destroy more or less, depending on the temperature of the water, the vacuum on the suction side of the water piston and prevent a sufficient supply of water from entering into the pump, and at a certain temperature the pressure due to this vapor will be so great as to cause a failure in the action of the pump. Manufacturers of pumps will give the highest temperature of the feed water at which their pumps will work.

(68) E. M., Joliet, Ill., writes: Please inform me how cold saws are tempered. *A.*—We made inquiries at a saw works in regard to tempering saws of this kind, and were informed that they are hardened in the same way that saws for wood are hardened the only difference being in drawing the temper, which for wood saws is brought down to a blue, while cold saws are sometimes left as they come out of the oil bath. Saws for wood are tempered in the following manner: The saw is first heated to a light cherry red, and then plunged into a bath composed of whale oil, tallow, rosin and beeswax, the proportions of which we could not learn. After taking the saw out of the bath it is cleaned by scraping and scouring with sawdust. For drawing the temper the saw is placed between plates brought together by hydraulic pressure. The plates or dies are circular in form and horizontal in position and placed in furnace with an adjustable blast, and are revolved to keep the temperature even. There is danger that cold saws when taken out of the bath are too brittle and may cause serious results when put in use. In such cases, of course, the temper must be drawn as described above.

(69) E. C. S., Wichita, Kan., writes: Kindly give me the significance of all characters, or at least of those which are most generally used, such as $\pi = 3.1416$. *A.*—The characters to which you refer are letters in the Greek alphabet, of these there are only two letters to which writers generally give the same significance, namely, π called pi, which nearly always signifies the ratio of the circumference to the diameter of a circle, and this is equal to 3.1416; the other letter is Σ called sigma, which generally signifies the sum of a number of quantities; but it must be understood that even these letters have sometimes another significance. The letter Δ called delta often signifies small increments of matter; the letter τ called tau often denotes absolute temperature; the letters Θ called theta, and Φ called phi frequently denote some particular angle; μ called mu is sometimes used to denote a coefficient, and η called eta occasionally denotes efficiency. When a writer does not give the significance of the letters π and Σ it is generally safe to attach to them the meaning as given above. But it is not safe to assume any significance for any of the other letters or characters, their significance is generally given or indicated in the text in which they are used.

(70) J. H., Plainfield, N. J., writes: Kindly give me a formula for computing the safe tension of a screw with square and V-threads. *A.*—We understand you to ask for a formula for computing the safe load on screws or bolts. The safe working stress in iron screws or bolts is generally taken at 10,000 pounds per square inch, and 12,000 pounds per square inch for steel. Let P = safe load in pounds, and d = diameter of the bolt in inches at the bottom of the thread. We then have

$$P = .7854 \times d^2 \times 10{,}000 \qquad (1)$$

for iron bolts, and

$$P = .7854 \times d^2 \times 12{,}000 \qquad (2)$$

for steel bolts. Since $.7854 \times d^2$ gives the cross-sectional area at the bottom of the thread, the above formulæ may be read as follows: The load in pounds which the screw can support is equal to the cross-sectional area of the bolt at the bottom of the thread, multiplied by the safe working stress in pounds per square inch. To illustrate we shall take the following example: What is the safe load for an iron bolt whose diameter at the bottom of the thread is 1½ inches? Here we have

$$P = .7854 \times 1.5^2 \times 10{,}000$$
$$= .7854 \times 2.25 \times 10{,}000 = 17{,}671$$

pounds. The strength of bolts depends on the diameter at the bottom of the thread, the form of thread does not enter in the computation, hence the above formulæ are applicable to V and square-threaded screws. It should also be understood that these formulæ are applicable to such bolts only which are not subjected to any initial stress. Bolts which hold the cylinder heads to the cylinder flanges, or those which connect two parts of a machine and are screwed up tightly before the effective load comes on the connecting parts are subjected to an initial stress due to screwing up, and this stress must be taken into account in computing the load which these bolts can support. It is, however, difficult to determine the initial stress put on a bolt by a workman. In cases where tight screwing up is to be expected all that can be done is to use a higher factor of safety, or, in other words, to assume a smaller working stress. For iron bolts, ¾ inch diameter and over, use 5,000 in place of 10,000 in formula (1), and for bolts less than ¾ inch diameter use 3,000 in place of 10,000; the reason for reducing the safe working stress in small bolts is to provide for the proportionately greater straining action which is liable to occur in small bolts due to screwing up. For steel bolts ¾ inch diameter and over use 6,000 in place of 12,000 in formula (2), and for bolts less than ¾ inch diameter use 3,600 in place of 12,000.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 132.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Cam-Milling. Machine Tool Works, Newark, N.J.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

70 Uses of Compressed Air mailed free. Clayton Air Compressor Works, 28 Cortlandt street, N. Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Drop Hammer Foundations.

BY CARL NORLAND.

As is well known to all hammer men, the fall of a hammer weighing perhaps a ton through five or six feet on an anvil makes a great blow, a great noise, a violent shock, and has a strong tendency to make screws and bolts work loose, and to break the hammer frames and driving parts, and even the hammers and anvils themselves.

It is also well known that the heavier the anvil in proportion to the weight of the hammer, the more effective the hammer blow, and the less the breakages. These advantages of the heavy anvil are perfectly understood, so that any hammer man would say at once that the anvil should not in any case be less than ten or twelve times the weight of the hammer, and that an anvil sixteen times as heavy as the hammer was much better than one only twelve times as heavy. This would seem to point at once to heavy and rigid hammer foundations as beneficial, both in increasing the effectiveness of the hammer blow and lessening the repairs, and I shall show that such an assumption is wholly correct, although very few hammer users believe that a rigid hammer foundation can be used without greatly increasing the breakages of both dies and hammer parts. Hammer men who have had no experience with rigid hammer foundations are firmly fixed in the belief that the true remedy for hammer breakages is increased elasticity of hammer foundation; they say that the breakages are due to the shock of the blow; they know that elastic foundations diminish the effect of the blow on the work, and hence draw the conclusion that the effect of the hammer blow

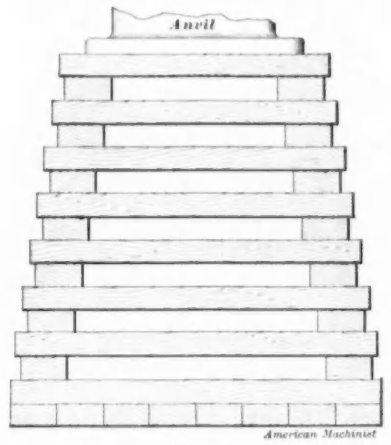


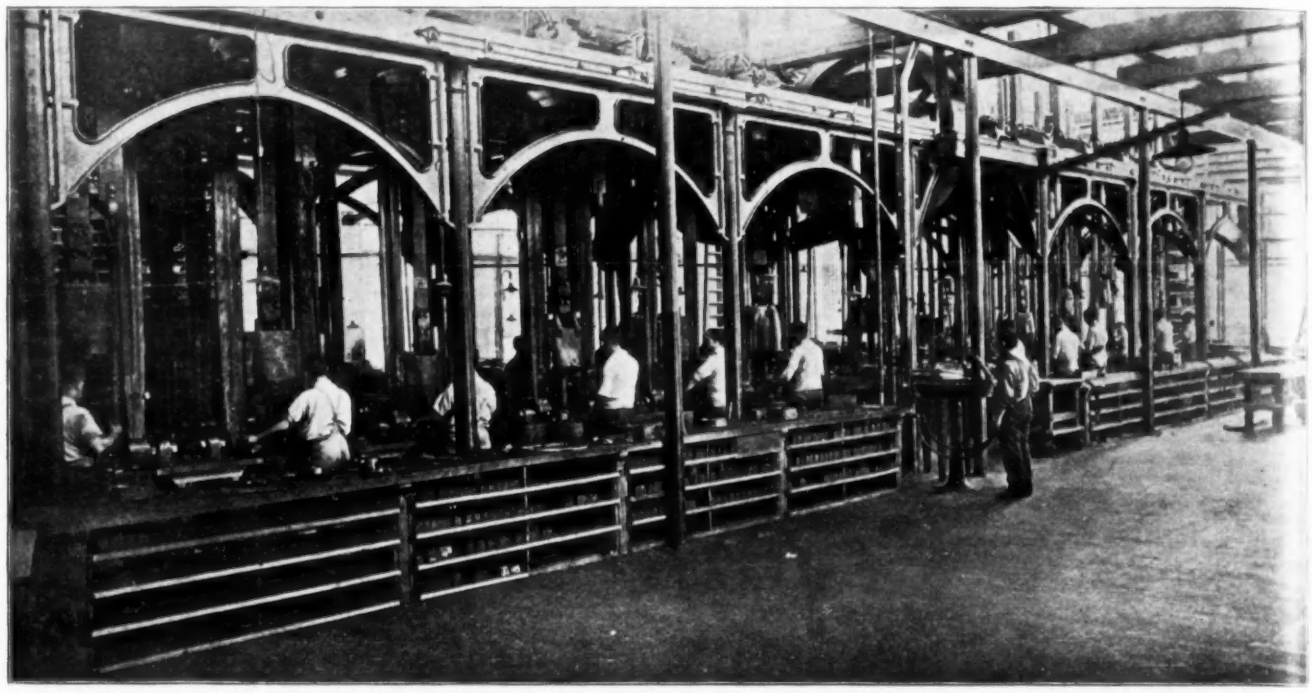
Fig. 1

on the various parts of the machine itself must be less detrimental in proportion as the foundations on which the anvil rests are elastic.

In the spoon shop the hammer foundations were as in Fig. 1, a "cob house" of railroad ties, oak, I think, built up in a pit dug in a coarse sand, and the pit filled with the same sand that was dug out of it. I do not now remember what the cob house rested on, but I think the bottom was made of two floors of the oak railroad ties, one crosswise of the other, and the ties laid close together in these floors; I do not know how the ties built into the "cob house" were secured together, but think they were held in place by the sand with which the pit was filled, and nothing else. I saw this structure of ties in a partly filled pit on one occasion only, and did not ask any questions about it. There were some eight or ten of these hammers of various sizes of the "Stiles" automatic pattern, and I think some "Peck" drops; with the "Peck" drops I had nothing to do; the "Stiles" drops broke with surprising regularity, generally in the neck of the uprights, just above the foot that was bolted to the anvil; this was not the only breakage by any means; screws and small parts gave way as well as the uprights, but the uprights were the biggest pieces, and so I remember them best; I know we had new uprights for the spoon shop under way, about all the time I knew the job. I knew less about hammer foundations then than I do now, and believed what the maker of the hammers and

the foreman of the spoon shop told me; that for some unexplained reason it was impossible to secure sufficiently elastic foundations for these particular hammers, hence the continual vexation of breakage, delay, and expensive repairs. I know now that the hammers had not nearly enough anvil, and that the very great elasticity of the open work wooden foundation, which only formed a sort of snow shoe to keep the hammer from sinking down bodily out of sight into the loose sandy soil on which the spoon shop stood, was the chief factor which assisted the hammer to knock itself in pieces.

The magnificent shops of the Gorham Manufacturing Co., silversmiths, Providence, R. I., contained nothing more surprising or noteworthy to me than the double bank of twenty-four drop hammers shown in general view in Fig. 2, and in plan and elevation in Figs. 3 and 4. Accustomed as most of us are to associating noise and dirt, and patches and seeming confusion with a drop-hammer shop, this beautiful structure in the midst of a lofty, well-lighted room, the clean workmen, and the absence of all jar or vibration, and the seemingly slight noise of the hammer blows, made a most forcible impression on my senses. As to the hammers themselves, I am not at liberty to speak; they were designed and built by Mr. J. M. Bogle, the superintendent of the Gorham Company's tool makers, and contain new features which have not been made public. The anvils are heavy, but not so heavy as to at once account to the observer for the perfect steadiness with which they take the blows of hammers ranging from 250 pounds for the lightest, to 1,933 pounds for the heaviest, a steadiness so surprising that I at once asked Mr. Bogle (who was showing me through this superbly equipped establishment, without doubt one of the finest work shops in the world, certainly, by far, the superior of any I have ever seen) why the hammers stood so still while at work. "It is the foundation," said Mr. Bogle, in reply, "just the foundation, nothing else at all; the superstructure has nothing to do with the steadiness; it is convenient and ornamental, and permanent and economical, and all that, but it is the foundation which makes the hammers stand still, and makes the blow so quiet and so effective." I secured the photograph giving the general view here shown, without much difficulty; the detail drawings I obtained only after long discussion, the management of the Gorham Company at first holding that they had been at a large expense, something like $20,000, to put up this bank of hammers in direct opposition to all existing practice, and that it would be folly to instruct their rivals needlessly. The view that first, it was for the general good that successful practice should be known, and next, that the information as to the general construction of the foundation of these hammers was, after all, open to diligent search, through the mechanics who constructed it, finally prevailed, and the detail drawings were given to me with permission to publish them. The photograph of the general view, and the drawings of the details are so clear, that I need give but little in the way of description. The soil of the low hill, which is crowned by the noble pile of building constituting the Gorham shops, is a coarse sand. This was dug out to the depth of nine feet, and the space for the hammer foundations was inclosed with retaining walls, and a floor of 12 inches of sharp granite chips, mixed with Portland cement, was first laid down, and on top of this two courses of granite ashlars were laid to sup-



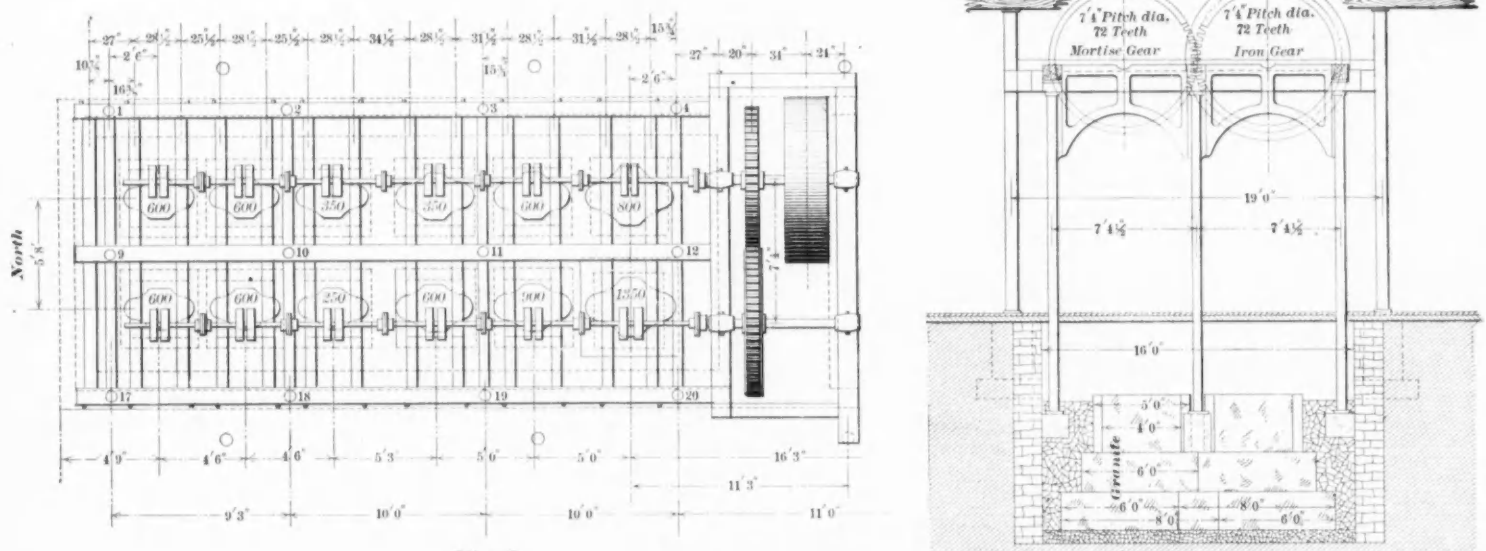


Fig. 3

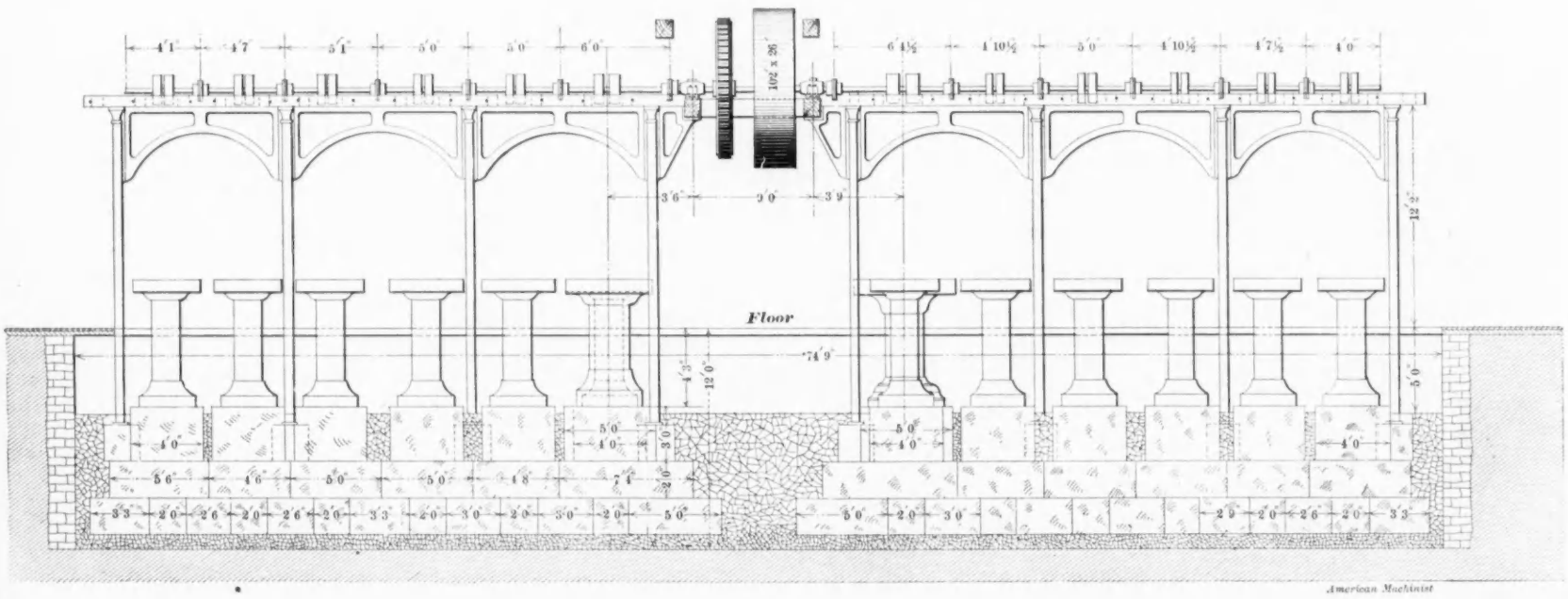


Fig. 4

Drop Hammer Foundations.

port the individual anvil blocks of granite, all laid in Portland cement, and all filled and united as shown in the detail, with sharp granite chips in Portland cement. The drive is a pulley 102 inches diameter by 26 inches face, carrying a 24-inch driving belt (which, it may be observed, is one inch of driving belt width for each hammer driven) and the gear between the two lines of lifter shafting is an 88-inch iron spur driving an 88-inch mortise gear, 72 teeth in each.

Although the Gorham Company and Mr. Bogle are not alone in their belief in rigid hammer foundations, other large users of hammers are not in line with the Gorham practice. The old tradition of the elastic foundation governs prevailing usage. Thus the Billings & Spencer Co., of Hartford, with whose fine forgings almost every machinist in the country is familiar, and Mr. Williams, of Brooklyn, who has furnished a lavatory and baths for the use of his hammer men, far better than was ever before put in any shop, to my knowledge, and whose ability to produce excellent drop forgings is very widely known, use substantially the hammer foundations shown in Fig. 5, each hammer having an individual foundation, varying in horizontal section somewhat in proportion to the size of the anvil base.

The Billings & Spencer and the Williams hammer foundation is shown, from description only, in Fig. 5. My thanks are due to both the Billings & Spencer management

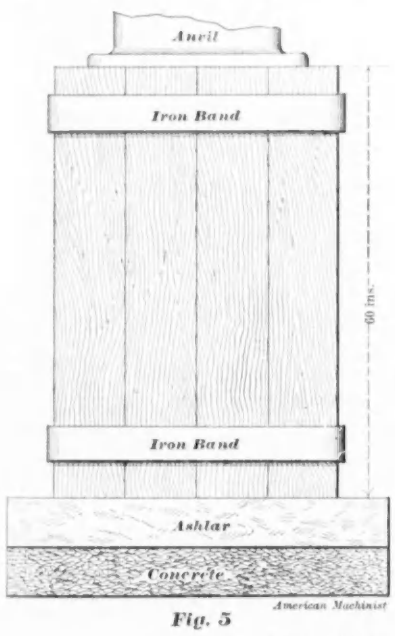


Fig. 5

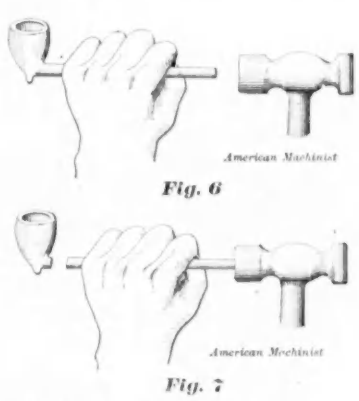


Fig. 6

Fig. 7

DROP HAMMER FOUNDATIONS.

and to Mr. Williams for their efforts to secure exact information for me in regard to the precise construction of their hammer foundations, but no drawings of either could be found. The Billings shops stand on a natural soil; the Williams shops are on made ground; I was not informed that the Billings foundation had anything between the timber ends and the soil; the timbers were said to be about 9 feet long. The Williams foundation is in made ground, and has first a foot of concrete in Portland cement, then a granite ashlar (dimensions unstated), and then 60 inches of yellow pine timbers on end, banded together, probably as shown, and the anvil base set directly on the ends of the timbers.

The Gorham anvils rest on ⅛-inch thickness of leather, the best leather belting, placed between the anvils and the granite anvil blocks. Rubber sheets were tried in the same place, but did not stay. The leather stays and its fibers distribute themselves so as to make a perfectly even bearing all through between the bottom of the anvil and the top of the granite anvil block.

The horizontal area of the Williams timber foundation was said to be a little larger than the anvil base, perhaps from 3 inches to 6 inches on a side larger. Mr. Williams searched his books in vain for an exact record, and the precise details had also passed from the minds of the workmen, and no drawings could be found to give dimensions.

In one of the large brass shops in Waterbury, Conn., a young superintendent reasoned out the matter of hammer foundations to his own satisfaction, and having the courage of his convictions proceeded to put his drop hammers on the finest of all possible foundations, a solid natural rock, which lay under an extension of the factory buildings, where he proposed to locate a lot of hammers previously in use in another part of the works. A well disposed "old hand" remonstrated with the youthful superintendent privately and kindly, telling him that the long experience and hoarded wisdom of the old hand instructed him that hammers placed on a solid rock foundation would pulverize themselves at the first blow, to say nothing of the sure destruction of any dies placed between the hammer and anvil. For all that the hammers went down on the rock. The "old hand" was ordered to set a pair of dies in one of them, and against his rueful protest to put in a piece of work and strike a blow, which he did, giving the same drop to the hammer which had been previously used for the same dies on a soft foundation.

The result was to break the die in several pieces, and the old hand bent a reproachful gaze upon the young superintendent.

"Put in another set of dies," said the youth, "and give a blow with half the lift of hammer."

"But that is the lift the hammer always had for that set of dies," cried the old hand, aghast at such a contravention of established practice.

"Strike the blow with half the lift," said the super.

"It won't do nothing," said the old hand.

The blow at half lift was struck, and the effect on the work was found to be greater than at the double lift on the soft foundation.

It was a long time before the old hand could be reconciled to doing his work at an average of about half the old hammer lift, but he finally became outwardly resigned, though he still maintains that he "never see nothing like it, and don't think the hammers do nigh so well" as they did on the old soft foundation. It is indeed a sad moment when the garnered wisdom of past experience is rudely thrust aside by a successful innovation, but the drop hammers stand on the rock with only a thickness of leather belting between the bottom of the anvils and the hewn top of this natural foundation, and breakages are rare indeed among them.

The Williams hammers and the Billings & Spencer hammers have breakages. Mr. Williams told me they had broken every piece of a hammer, anvils, hammers, uprights and all. Various makes of hammers are used by both the Billings & Spencer and the Williams shops. Mr. Williams believes his best hammers to be those ordered of the Waterbury-Farrel Foundry, with no restrictions, and built by the day. They were costly; they have steel hammers and heavy anvils, but they do a great deal of work, and call for few repairs.

The case of the drop hammer is precisely that of the tobacco pipe in Figs. 6 and 7. Inertia is the hand that holds the uprights in place while the blow of the hammer sends the anvil flying away from them as the bowl of the pipe leaves the stem when the hammer falls, as in Fig. 7. The heavier the anvil, and the more nearly immovable the anvil, the less likely the uprights and anvil are to part company. Under a comparatively recent date Mr. Bogle writes me as follows:

DEAR SIR: I have mailed you under separate cover plan of stamp hammer foundations, which you so much desire, and Mr. Robinson directs me to state in connection with this that he hopes it will not be used for other than honorable purposes.

Regarding the use of stone foundations for stamp hammers, I am convinced that when properly laid they are absolutely and unqualifiedly correct; this conclusion has been arrived at not by theory alone, but after years of practical experience with this and other kinds of foundations.

The stones used in this case are granite ashlars laid close in Portland cement on a bed of concrete 9 inches thick, composed of Portland cement and small sharp granite chips. The spaces between the top stones on which the anvils rest, and wall of pit, etc., are filled in with the same material, except that the granite chips are larger, as illustrated, thus making one compact and united mass. After more than four years of continued and severe use with hammers weighing from 300 pounds to 2,000 pounds each, falling variable distances, from 3 feet to 5 feet, there is not the least indication of settling, nor has any other bad feature manifested itself, neither do I expect any. Again calling your attention to Mr. Robinson's wish as expressed above, I remain,

Yours truly,

JOHN M. BOGLE,

Master Mechanic Gorham Mfg. Co.

Boiler Inspection in New York State.

The ninth annual report of the New York State Factory Inspector's Report was recently made public, and shows that a very useful work is being done by him and his assistants. Much attention is devoted to seeing that laws respecting employment of labor safeguards, sanitary conditions, etc., are enforced, and it is stated that with very few exceptions employers have heartily cooperated with the inspectors in abating abuses.

Regarding inspection of steam boilers, the report says:

The necessity of some proper supervision over the steam boilers in use in this State is still as apparent as ever. There are many boilers in use which have never had an adequate overhauling; both the persons in charge and the owners relying on luck to prevent disasters. In the majority of cases the engineer is also his own fireman, and he has neither the time nor the knowledge to inspect the boiler under his care. It is not uncommon to find the boiler and engine in a factory in charge of a boy who is no engineer, but some cheap hand who is given the job because of his willingness to take chances and work for low pay. To put the lives of employes in charge of such a person as this is morally criminal, perhaps, but there is no law to prevent it or to punish the responsible parties. The cities of New York, Brooklyn and Buffalo have local boiler inspectors and boards for examining engineers, but the rest of the State is in no way protected by such officers. We have suggested in previous reports that a system of steam boiler inspection be established, and that all boilers not insured in some responsible company be periodically visited and inspected by some one so empowered. The steam boiler insurance companies have a corps of inspectors to regularly inspect their risks, and it can therefore be reasonably presumed that such insured boilers are kept in a sound condition. But it is usually the boiler that is not insured, and which is, as a consequence, rarely inspected by a mechanic, that is really dangerous. We have known instances where insurance companies refused to insure a defective boiler, after examination, and yet the owners continued to use them, and jeopardize the lives of all within and in the vicinity of the premises. Only a few years ago five lives were lost in a boiler explosion in the interior of the State, after the engineer had warned his employers that the boiler was unsafe. The man was told he could continue to use that boiler or lose his job, and he lost his life among the rest in consequence. We recommend that a law be passed placing the duty of inspecting steam boilers in charge of some competent authority, and that all persons desirous of running stationary engines or steam boilers be examined by officers appointed for that purpose.

How to Use Plumbago Crucibles.

Mr. John A. Walker, vice-president Jos. Dixon Crucible Co., gives some important hints on the use of plumbago crucibles. He says:

"The hurry of the modern world and the short cuts forced on the foundry men by excessive competition have reached even the melting shop where the plumbago crucible is used. To illustrate: A melting, or, as it is termed in shop parlance, a 'heat' used to take 2½ to 3 hours. In many shops that time is now reduced to 1½ hours, or, in a case mentioned the other day, to one hour. This, of course, means a better furnace, a better draft and a much higher temperature. Consequently the crucible receives a much greater punishment.

"Let me offer a hint which I believe will be helpful. The melter should invariably have at his command both new crucibles and old crucibles. By new crucibles I mean those that have not been used at all, and by old crucibles I mean those that have been used three or four times.

"When the fires are started in the morning and the heat of the fire is low, then, after suitable annealing, put in a 'new' crucible so that it may receive its first heat gradually in a slowly increasing fire. Later on in the day when the first and second heats have been taken off and the fire is at its severest—the very highest point, never take a new pot, but always take one that has been in the fire before.

"If, in the second or third heat, when the temperature of the fire is way up, a new pot is put in the chances are it will 'fly' or 'scalp,' as it is called; whereas, if the melter will take an old pot, that is, one that has had its second, third or fourth heat, this accident will never occur.

"The mixture of the plumbago crucible contains ingredients, that, at a sufficiently high heat, ooze out in a vitreous or glass-like form and, after flowing down the sides of the crucible, sets, covering it with a protecting coat. A crucible that has this vitreous coat already developed by use in the first or second heat, can, later on, be put into as hot a fire as the melter please, and will never 'fly' or 'scalp.'

"By observing this hint the melter can not only save his crucible but will prevent himself from asking reclamations from the crucible maker which are usually desired, as the crucible maker knows that if a crucible 'flies' or 'scalps,' 99 cases out of a 100, it is because a new crucible has been put, not in the early or slow fire, but in the highest and fiercest fire where only an old crucible should be put.

"In brief, to repeat, the best and safest practice is to save the new pots for the low temperature, and reserve the ones with the vitreous glaze for the higher and highest heats. As a melter will always get from 15 to 40 heats out of a crucible, he can always manage to keep a supply of what I have termed 'old' crucibles on hand to be used in the hottest fires, and can use his 'new' crucibles in the low fire where they will be tempered and glazed."

By an oversight the second portion of Mr. Duncan's lecture on "The Mechanism of the Pocket Watch," published last week, appeared without credit to the Franklin Institute, though this credit was given in the first part published in a previous issue. The lecture is published in the February number of the *Journal of the Franklin Institute*, and our thanks are due to Mr. Duncan and to

Dr. Wm. H. Wahl, secretary of the institute, for courtesies extended in connection with our publication of it.

We wish to particularly caution our readers against sending original and; perhaps, valuable letters of recommendation to persons unknown to them, when answering advertisements. We are quite often put to a good deal of trouble on account of letters of recommendation which have been inclosed and not returned, and we are appealed to to recover them. This we cannot always do because it sometimes happens that they are mislaid, and, perhaps, permanently lost. Copies of such letters will usually answer just as well, and the originals should be retained; at least until the person to whom they belong knows who he is corresponding with.

NEW CATALOGS.

We have received from the Pratt & Whitney Co., Hartford, Conn., a finely illustrated and printed catalog of machinery designed especially for use in the manufacture of bicycles. This catalog is 10½" x7¼", and is sent to those interested on application.

Messrs. J. H. Williams & Co., Brooklyn, N. Y., have issued a catalog which was primarily intended for distribution at the recent cycle show in New York. In it are elegant illustrations of a line of drop forgings for bicycle parts. This catalog is 11⅜"x8".

The Engineering Appliance Co., Jamestown, N. Y., send us their catalog of specialties for engineers. These consist of an improved indicator, reducing motion, averaging planimeter, etc. They also illustrate a bench lathe of their manufacture for fine work.

The Garvin Machine Co., Laight and Canal streets, New York, have issued a special catalog of bicycle machinery in which they illustrate the line of machinery which they have found most useful to bicycle manufacturers and in bicycle repair shops. It is a well gotten up and interesting catalog, 8½" x11¼".

We have received the third edition, revised and enlarged, of "Graphite as a Lubricant Scientifically and Practically Considered; also its Value as an Accessory for Engineers and Machinists." It is published by the Joseph Dixon Crucible Co., Jersey City, N. J., and contains considerable information of interest to those who have to do with lubricants. It is sent to any address upon application.

We have received from The Frasse Co., 19 Warren street, New York, a 6¾"x10¼" catalog of tools, machinery and supplies which is intended especially for consumers, and in which net prices are given. The catalog is on many accounts better adapted to mechanics and others who buy tools in small quantities than the larger catalog, and is sent on receipt of 8 cents in stamps to pay postage. This is called Catalog No. 22, and should be so designated in writing for it.

One of the finest catalogs that has been issued for a long time is that of the Nicholson File Co., of Providence, R. I. Its pages are 11 inches by 14½ inches, and it is embellished with lithographs and wood cuts of fine quality, illustrating the works of the company and its products. Besides the interest which naturally attaches to views of a noted manufacturing establishment such as this is, the engravings of files will be of especial interest to those who have to do with files, because they are here shown (life size in most cases), and so clearly as to be readily identified, the proper names being in each case appended, so that selections can be made from it almost as readily as if the files themselves were presented for inspection. Two pages are devoted to sections of files of regular kinds and sizes with their proper names—pages which, of course, will be especially useful. The catalog is, of course, too expensive for entirely free and unrestricted distribution, but by applying to the company information regarding this point can be obtained.

MANUFACTURES

W. S. Loomis is having plans made for a proposed power house to be erected at Holyoke, Mass.

The management of the Gilmanton Mills at Belmont, N. H., intend erecting an additional building the coming spring.

H. J. Beebe is interested in the project of erecting a factory building at Indian Orchard, Mass., for the manufacture of fiber carpet.

The upper plate-mill and the 65-inch mill of the Pottstown (Pa.) Iron Co. has resumed operations, after an idleness of over three months.

T. H. Buck & Co. intend constructing at Chelsea, Mass., a brick engine-boiler-house and mill, the latter structure to be about 100 feet square.

The Schenectady Gas Light Co., of Schenectady, N. Y., have placed the contract for their new gas house roof with the Berlin Iron Bridge Co , of East Berlin, Conn.

Engineer A. B. Tower, of Holyoke, Mass., has completed plans for the new mill which the Webster & Ring Manufacturing Company are to erect at Orono, Me.

Heyl & Patterson, of Pittsburgh, are putting in a large billet conveyor for the Johnson Company, of Lorain, Ohio, which will be capable of handling billets 44x48 inches.

Capitalists are organizing a company with a capital stock of $100,000 to conduct the manufacture of augers at Taunton, Mass. It is proposed to erect a large factory building.

The Deuber Watch Works, Canton, Ohio, resumed operations January 7th, with a full force in nearly all departments. The Canton Steel Company also resumed operations January 7th.

The Schonland Brothers' new factory, Portland, Me., is completed with the exception of the machinery which is now being put in. The firm will occupy their new factory on or about January 1st.

The Washburn & Moen Mfg. Co., at Worcester, Mass., is to build an additional story of brick over the whole length of the mill No. 1, 86x27 feet, and make a two story brick extension, 41x27 feet, and 15 feet high.

The announcement of full running at the Davis & Furber Machine Co.'s Works, Lawrence, Mass., caused much rejoicing. A half hour daily has also been added to the schedule of the card clothing department.

Mr. A. G. Sinclair, late president of the New York Emery Co., a combination of emery manufacturers, has severed his connection with that company and connected himself with the Tanite Co., Stroudsburg, Pa.

The Delaware Rolling-mills, of Phillipsburg, N. J., resumed operations recently after an idleness of nearly a year. The American Sheet iron-mill also resumed work. Several hundred hands were given employment.

The finishing department of the Warren Rolling Mill, operated by the Union Iron and Steel Company, of Youngstown, Ohio, which has been idle since June, 1893, resumed operations January 3d. In a short time the entire plant will be in operation.

The Washburne Manufacturing Company, of Waterbury, Conn., has been organized with a capital of $5.000. The stockholders are: J. V. Washburne, Morrison, Ill.; Robert B. Greenwood, Waterbury; E. J. Steer, Waterbury, and E. N. Folsom, Waterbury.

Extensive additions are being made in connection with the Otis Falls Paper Co.'s mills at Jay, Me. A new finishing room 130x60 feet in dimensions and a heater room 60x130 feet in size are being erected. The latter structure will contain six power engines to be introduced.

There is yet a big demand for the location of mills in Pennsylvania. The trouble over the question of reopening a street through the Wellman Iron and Steel Company's plant at South Chester, Pa., has been the means of flooding the officers of that county with offers of sites in the State.

The Union Steel Company has filed articles of association at Indianapolis, Ind. It has a capital of $500,000, and is a union of the Depauw Steel Company and the Bessemer Steel Works. It is the intention of the incorporators to build one of the largest steel factories in the country at Alexandria, Ind.

A new industry has been established in Lynn, Mass., known as the Rubber Felting Shoe Co., of which the treasurer is D. W. Palmer, of Amherst, and the superintendent H. C. Richardson, formerly of Maryland. As the name implies, the business is that of making felt shoes with a rubber sole and foxing.

The Fairfield Lawn Swing Company, now located in Fairfield, Me., has agreed to consolidate with the Brunswick Company and organize a corporation with a capital of $30.000 to locate in Gardiner, Me., on condition that the citizens of Gardiner will take stock in the new company to the amount of $8,000.

The Farrel Foundry and Machine Co ,of Ansonia, Conn., have decided to build a new roll and machine shop, and have placed the contract for the building with the Berlin Iron Bridge Co., of East

REDUCING VALVES

For reducing and maintaining an even steam, air or water pressure. These valves have been on the market for years, and are used by all the best and largest steam plants of the world.

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BUFFALO FORGES. Americas Best. The World's Standard. Buffalo Forge. Buffalo, N.Y. U.S.A.

Steam Engine Catechism, By Robert Grimshaw, M. E. 18mo, Cloth, - - $2.00. John Wiley & Sons, New York.

GRANT GEARS

Ready Made Iron Gears. Ready Made Brass Gears. Gears Made to Order. Gear Cutting. 1895 Gear Book, Free. Treatise on Gears, $1.00. GEORGE B. GRANT, Lexington, Mass., and 125 South 11th St., Philadelphia, Pa., and 86 Seneca St., Cleveland, Ohio.

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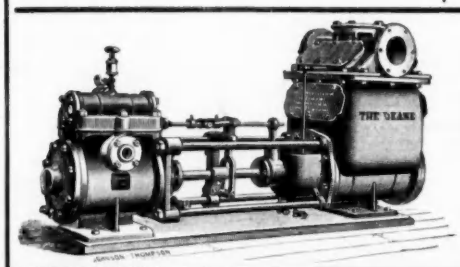

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SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.

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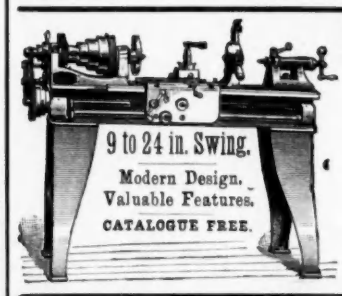
B. M. JONES & CO., BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.



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FOR LAGGING LOCOMOTIVE BOILERS.

Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,

87 Maiden Lane, NEW YORK.

Berlin, Conn. The building will be 104 feet wide and 260 feet long, constructed entirely of iron, brick and glass. The roof will be of copper.

The Lookout Rolling Mills, at Harriman, Tenn., which were built and equipped at a cost of $100,000, has been sold under a decree of the chancery court for $11,000. The concern was bought by the Harriman Iron Co., of which H. S. Chamberlain, of Chattanooga, is president. The plant will be put in operation at once, it is said.

Charles E. Dinkey has been appointed special assistant superintendent at the Edgar Thomson Steel Works. It is a new position just created. Mr. Dinkey's position comes in line next after Superintendent Gayley and Thomas Jones, the latter being assistant superintendent. He is a brother-in-law of C. M. Schwab, superintendent of the Homestead Steel Works.

The Washington Carbon Co., of Washington and Pittsburgh, Pa., are erecting a new plant for the manufacture of carbons for Brish electric lights. They have just placed their order with The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, for an outfit of tools to be used in making their molds, which includes one heavy slab milling machine arranged specially for work of this class.

The Tanite Co., of Stroudsburg, Pa., have brought out a line of artificial whetstones, which they think are especially well adapted to sharpening nearly all kinds of tools, such as mill picks, carpenters' and stone cutters' chisels, etc. They claim that the peculiar qualities of tanite are especially fitted for this purpose, and that the artificial whetstones made of it are entirely practicable and successful.

James B. Phillips, who has been superintendent and electrician at the Portland (Me.) Electric Works, has resigned and has organized a new company under the name of the Maine Electric Works, with offices at 27 Commercial street, the premises formerly occupied by the Giant Motor Company. The officers of the new company are: President, M. W. Lamb; treasurer and secretary, Orrie W. Neal; manager, J. B. Phillips.

The Brooks Locomotive Works, of Dunkirk, recently completed one of the new Brazilian locomotives to which more than ordinary attention is attracted. It is named the Fourth of July, by the direction of the Brazilian government, out of courtesy to the country in which the locomotives are being built. The Fourth of July is a handsome machine and is built more after the American type than the others constructed for Brazil.

The annual meeting of the stockholders of the Berlin Iron Bridge Co. was held at the office of the company, at East Berlin, Conn., on Tuesday, January 29th. The following board of directors was elected: Chas. M. Jarvis, Geo H. Sage, F. L. Wilcox and Burr K. Field, of Berlin, Conn.; S. Howard Wilcox, of Brooklyn, N. Y.; Julius Burr, of East Berlin, Conn., and H. Peck, of Waterbury, Conn. By vote of the stockholders, the capital stock of the company was increased from $300,000 to $500,000. The new issue of stock has all been taken by the old stockholders.

The Philadelphia Roll and Machine Works has acquired the grounds and works extending from Twenty-third to Twenty-fourth streets and from Washington avenue to Carpenter street, and has purchased from Mr. James Moore, drawings, patterns, templates, etc., of his works, known as the Bush Hill Iron Works. Mr. Townsend, who has been associated with Mr. Moore for the past 18 years, and is recognized as an expert on such work as has been done there, will have the management of the new concern, and every department of the works will be equipped with the best and most modern facilities. About the 1st of March it is expected that special buildings and furnaces will be completed, which will enable the largest of roll castings to be made.

Machinists' Supplies and Iron.

NEW YORK, February 9, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10 25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10.25 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—The market remains barely steady. A slightly better demand is reported. We quote L. X., 8⅛c. to 8¾c.; Cookson's, 8¼c. to 8½c.; Hallett's, 7.30c. to 7.35c.; and U. S. French Star, 8c.

Lard Oil—Prime City we quote at 53c. to 54c.

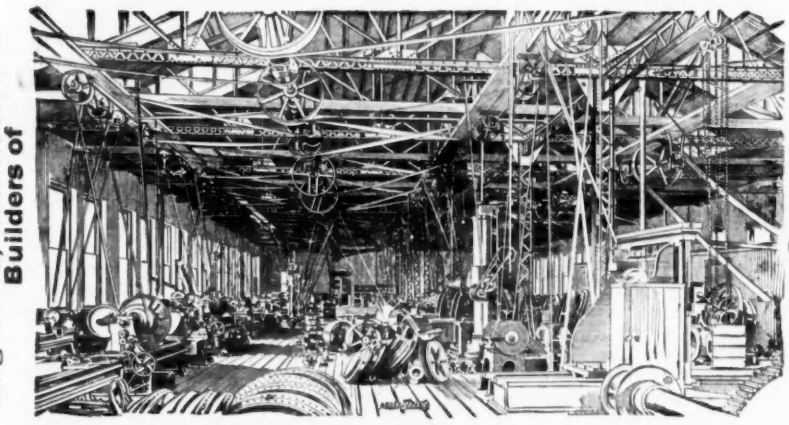
Copper—Business has not been very brisk. Second-hand Lake Copper has been sold at 9.80c., but producers hold out for 10c. Casting Copper has been sold at 9.30c.

Lead—The market is firm and steady; the demand is good. Nearly all business was done at 3⅛c. to 3.15c. for New York delivery.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

THE BERLIN IRON BRIDGE CO.
Office and Works,
No. 8 Railroad Ave., East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.



Engineers, Architects and Builders of Iron and Steel Bridges and Buildings.

The above illustration is taken direct from a photograph, and shows the interior of a Machine Shop, the Roof of which was designed and built by us for the Titusville Iron Co., at Titusville, Penn. The building is 70 feet in width by 205 feet in length. The roof trusses are made entirely of iron, and designed to carry shafting. Through the center of the building is a row of wrought iron columns. Machine shop roofs built after this plan are not only much neater in appearance than heavy, cumbersome, wooden trusses, but are stronger and stiffer; and where no wood is used about the construction the danger from fire is entirely eliminated.

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YOU WILL FIND THEM AT
FITCHBURG MACHINE WORKS, Fitchburg, Mass.
First Class Metal Tools
SEND FOR CATALOGUE E.
AND LIST OF GOOD
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INSPECT OUR
PRACTICAL POWERFUL PLANERS
AND OTHER METAL WORKING
MACHINERY.
48 IN. PLANER.
YOU will JUDGE them EXCELLENT.

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163 & 165 WASHINGTON ST.,
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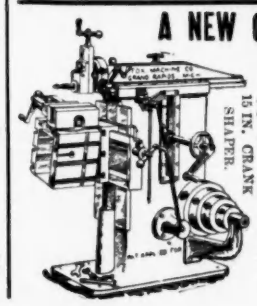

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NOTHING LIKE IT.
Fox Machine Co.,
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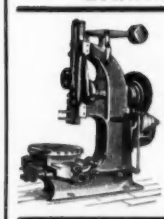
To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2 75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set.		31.10

These Goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.
C. W. LeCOUNT, South Norwalk, Conn.



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MACHINE TOOL BUILDERS,
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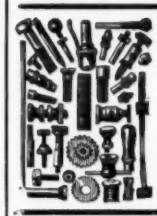

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Gear Cutting, Sheet Metal Stamping, Automatic Machinery built to order. Send sample or drawing for estimate.
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In reply to your inquiry about what I think of the STYRIAN STEEL, I would say that I made Sub-Press Punches and Dies of it and did work where I could not get any other Steel to stand, and I think it is the best Steel in the world, and I have tried about all of them.
Yours truly,
(Signed) GEO. M. GRISWOLD.
This Steel was Extra Tough and Hard.
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SHEARS AND PUNCHES.

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ALL KINDS IN STOCK.
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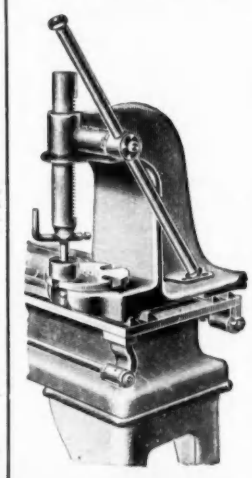

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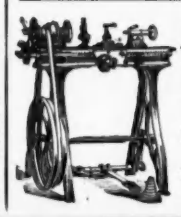
Send for Descriptive Circular.



Star Foot power Screw Cutting Automatic Cross Feed Lathes
9 and 12 inch Swing.
New Designs. Novel Features.
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HEAVY ACCURATE MACHINE WORK.
Our skill as machinists and the character of our machine shop facilities for heavy work are indicated by the 12-inch Breech Loading Rifled Mortars and Spring Return Mortar Mountings made for the United States Government. Pamphlet reprinting the official reports which describe these guns mailed upon application.

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163 and 165 Washington St.,
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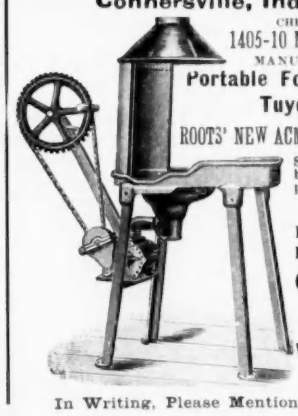

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FOR WATER WORKS.
SIMPLE, COMPOUND, OR TRIPLE EXPANSION,
HORIZONTAL OR VERTICAL
HIGHEST DUTY GUARANTEED.
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Spelter—The market is dull and weak. Quotations are from 3.15c. to 3.20c.

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✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 50 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Comp. mach't wants pos. E., Am. Machinist.

Wanted—Position by skilled mechanical draftsman, A1 references. Box 111, American Machinist.

Practical and experienced draftsman wants position. Address K., American Machinist.

Wanted—Position as junior draftsman or tracer by polytechnic graduate. Box 112, Am. Machinist.

Situation as foreman of foundry; experienced in all kinds of machinery castings. Address P. O. Box 1006, Providence, R. I.

Mechanical engineer, with long experience, desires to act as New York representative, or on the road, for machine shop. X. Y. Z., Am. Machinist.

Engineer (mem. A. S. M. E.) at present superintendent of manufacturing concern desires changing location to New England; will consider salary or purchase of interest. Box 100, care Am. Machinist.

Wanted—Superintendent, middle-aged, active, progressive and intelligent, to take charge of shop (in wood and iron line) employing about 175 men, and business increasing. Reply should be comprehensive as to past exp., with whom, nativity, age, and salary expected. F. C. Austin Mfg. Co., Carpenter street and Carroll avenue, Chicago, Ill.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—A purchaser for a good key-seater, by Mitts & Merril, 913 Tilden Street, Saginaw, Mich.

Wanted—To buy good second-hand tools. Box 83, American Machinist.

"Draftsmen's combination triangles clean, transparent, tough." D. J. Kelsey, New Haven, Conn.

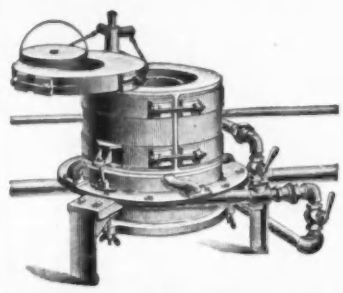
For Sale—A first-class key seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Model Locomotive Castings. Latest design. G. H. Olney, 163 Herkimer street, Brooklyn, N. Y.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

Wanted—Aluminum and brass castings to make, lowest prices for satisfactory work; prompt delivery; correspondence solicited. Twinning Campbell, brass founder, 153 Liberty St., Paterson, N. J.

Wanted—Good second-hand open exhaust heater; good make; size about 4 feet by 15 feet; give price and particulars. Address D. C. L. C., care of American Machinist.



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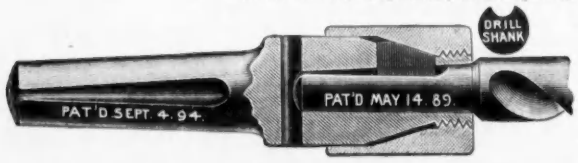

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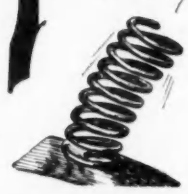

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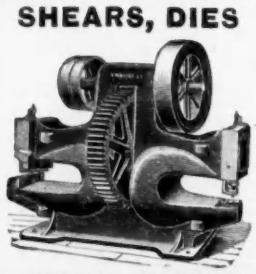

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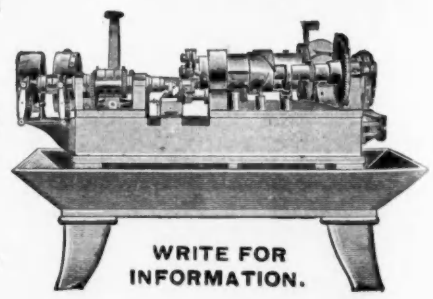

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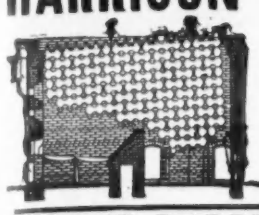

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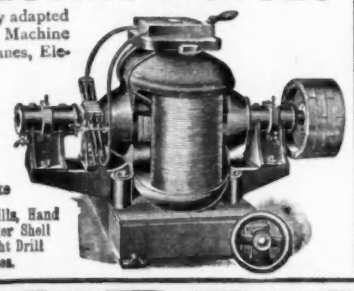

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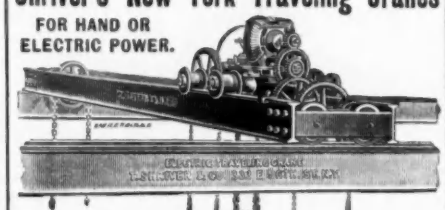

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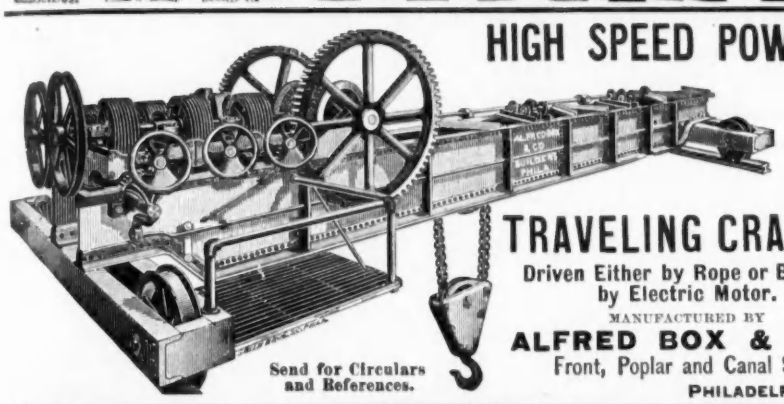

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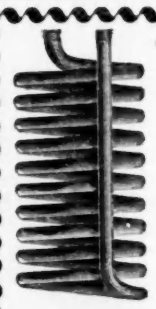

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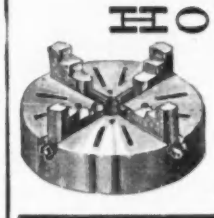

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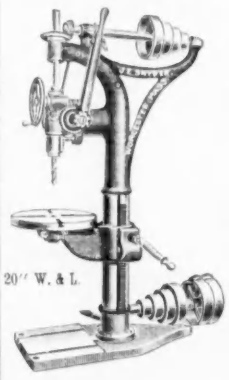

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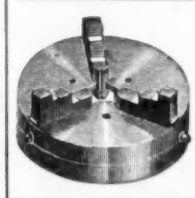

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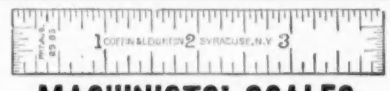

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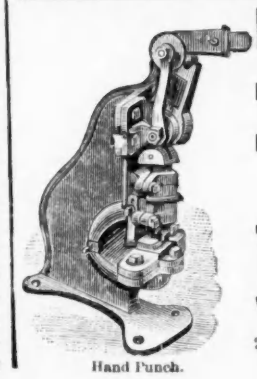

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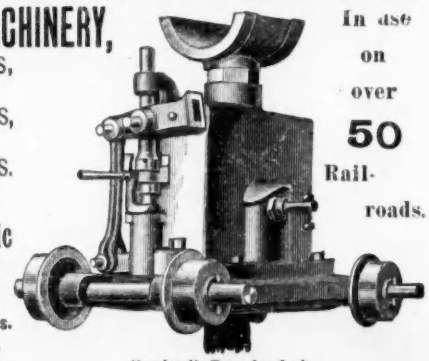

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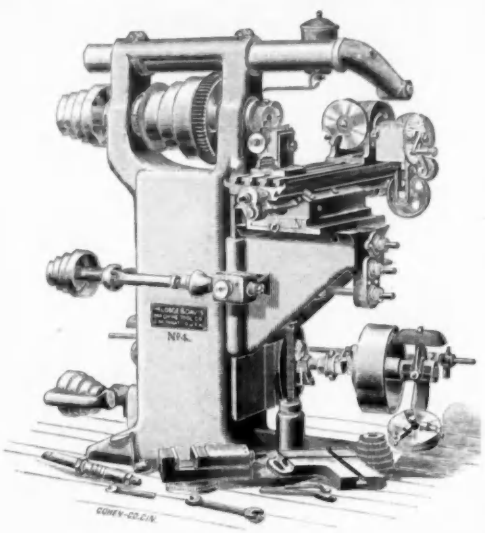

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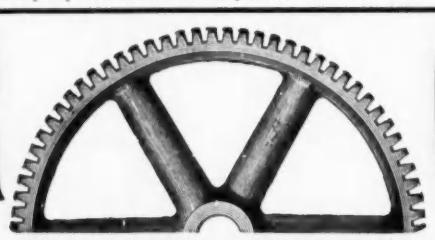

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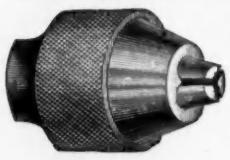

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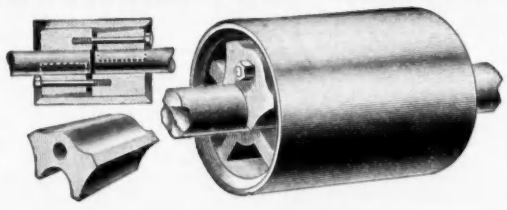

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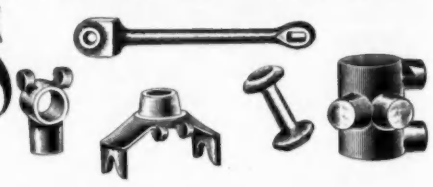

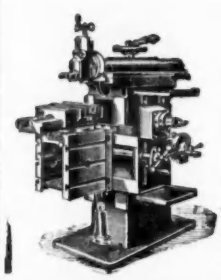

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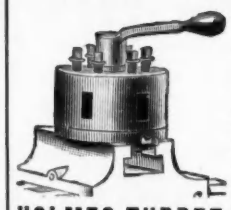

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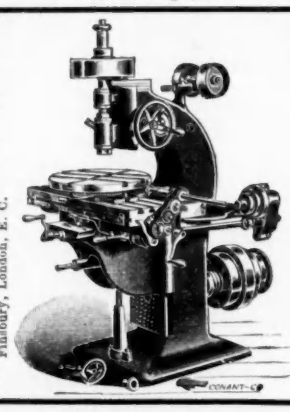

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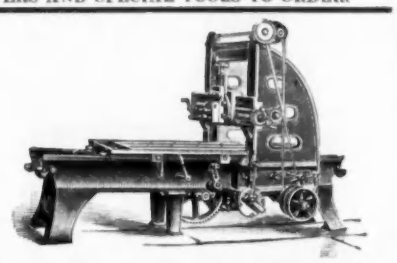

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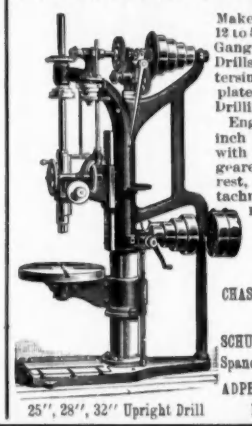

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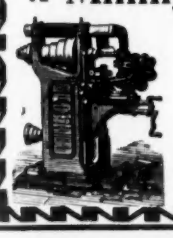

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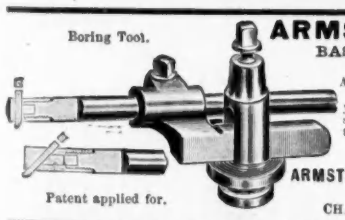

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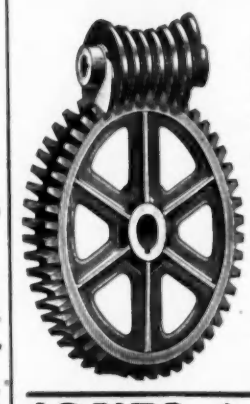

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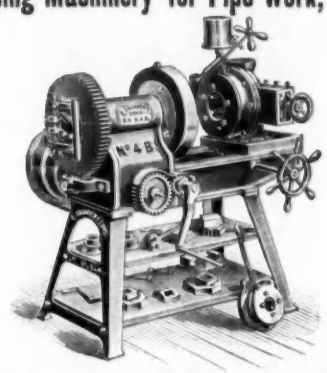

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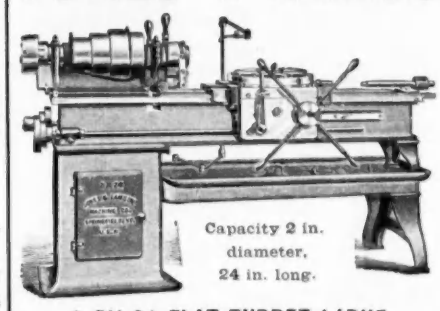

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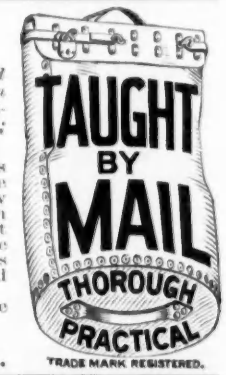

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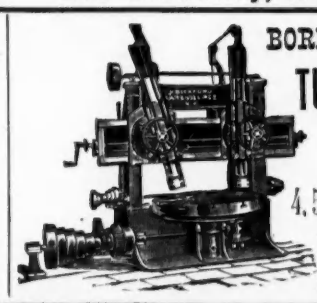

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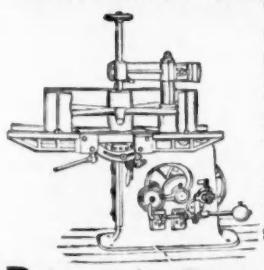

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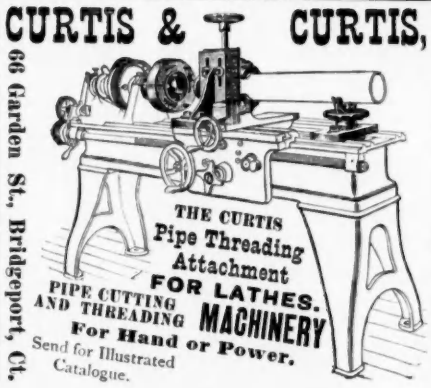

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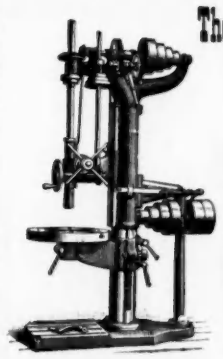

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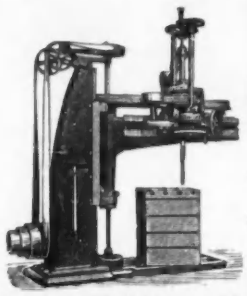

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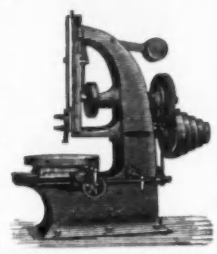

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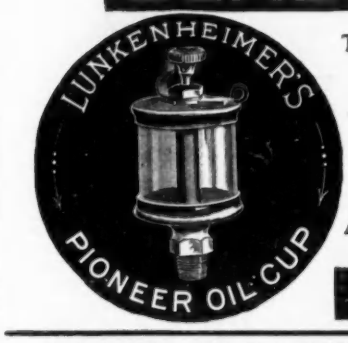

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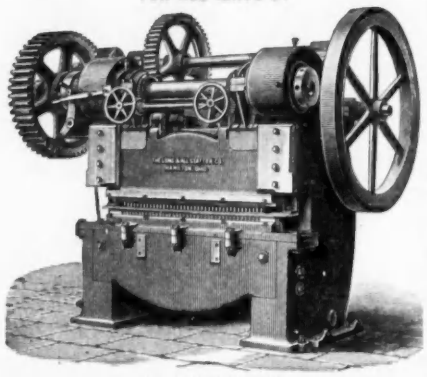

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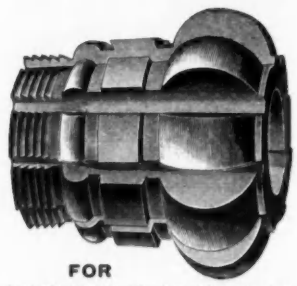

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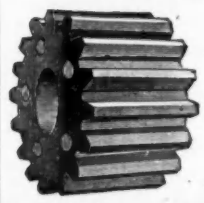

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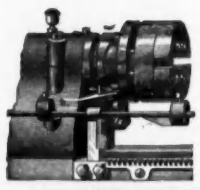

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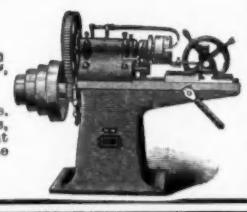

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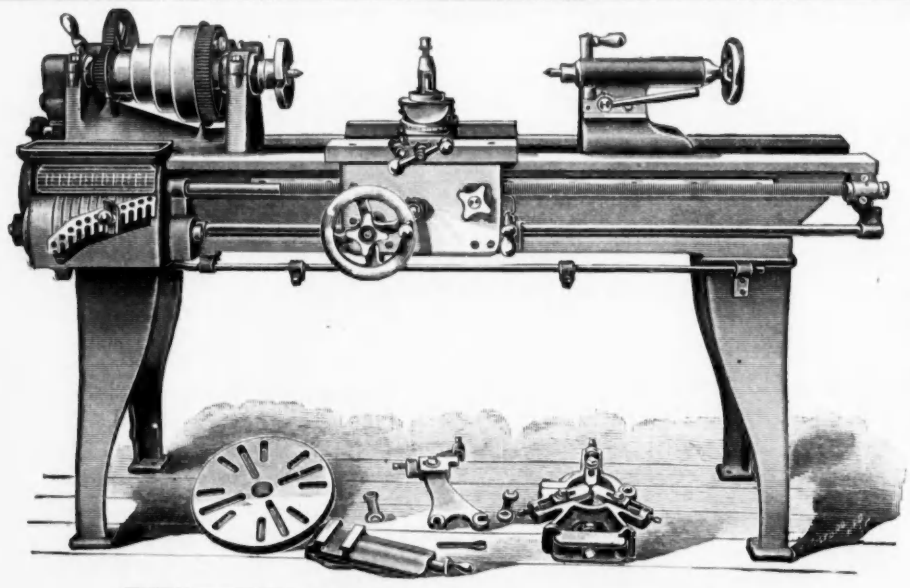

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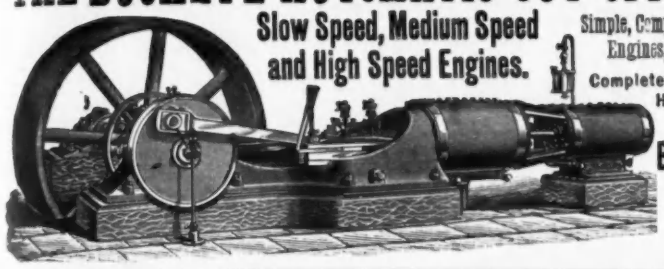

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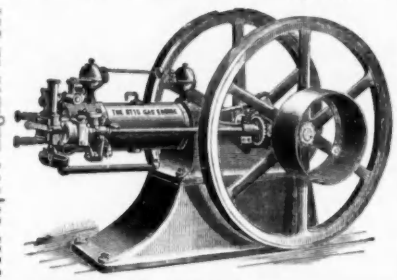

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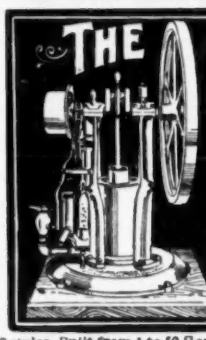

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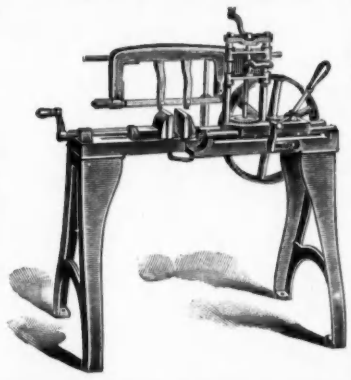

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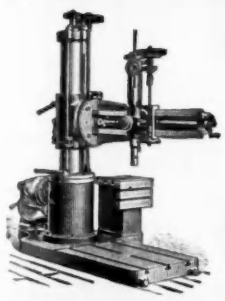

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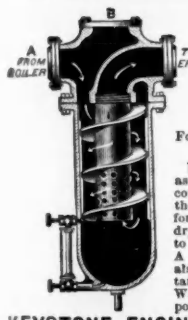

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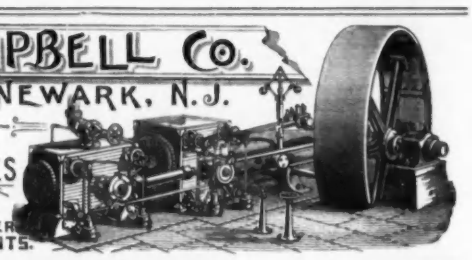

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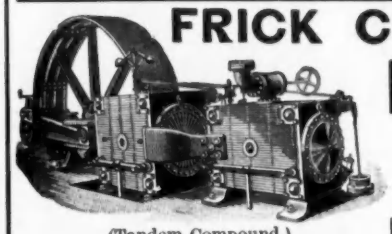

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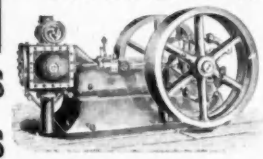

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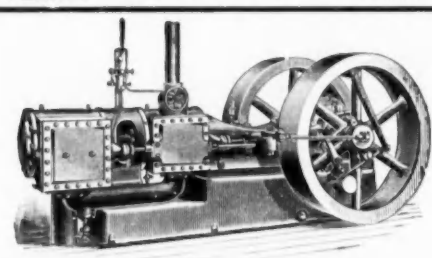

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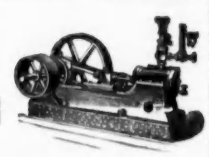

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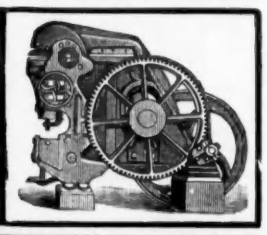

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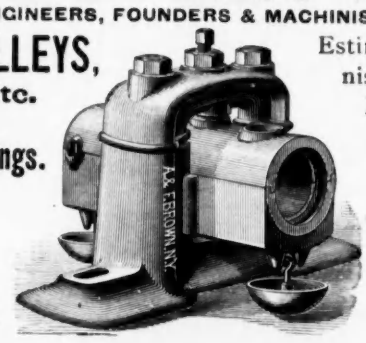

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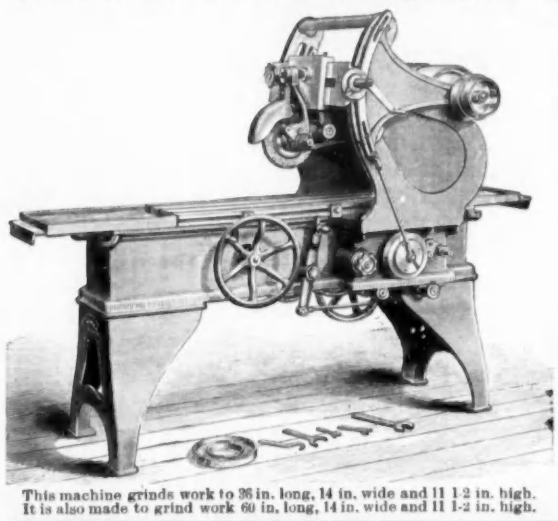

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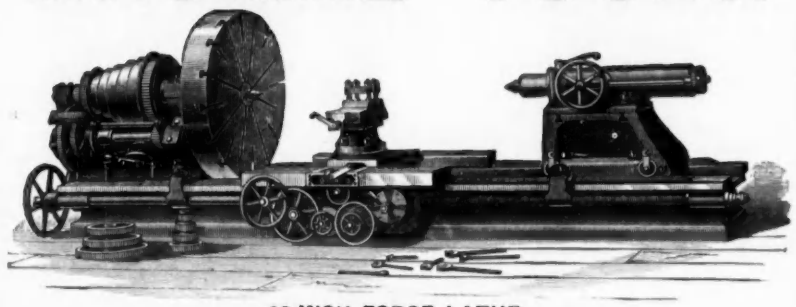

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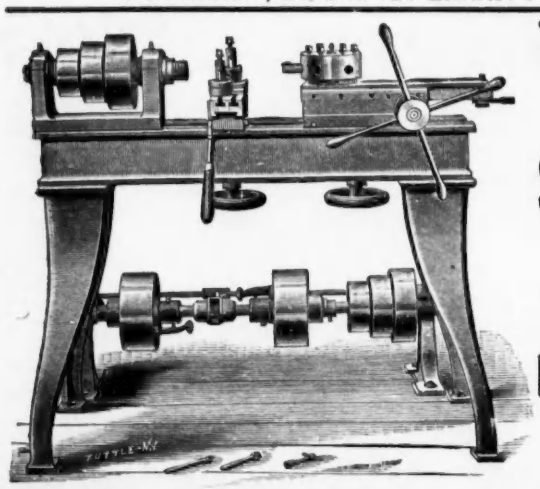

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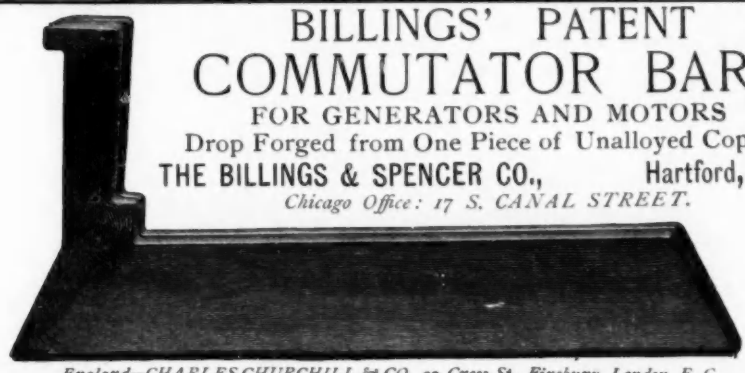

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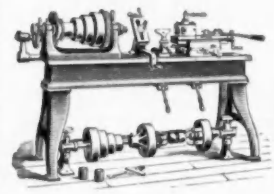

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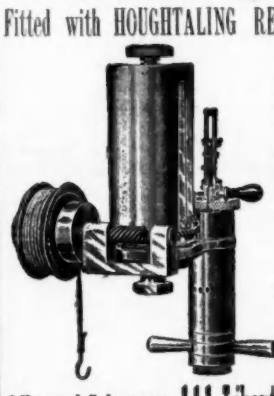

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